Compliments of Frank T. Shutt

Canada. Agriculture, Department of
Experimental Farms

THE EXPERIMENTAL FARMS

OF THE

DOMINION OF CANADA.

Bulletin, no. 1-20

DEPARTMENT OF AGRICULTURE.

OTTAWA:
1887.

The Experimental Farms

OF THE

DOMINION OF CANADA.

In Canada agriculture lies at the foundation of the nation's prosperity and involves interests of the greatest magnitude and importance. The vast area of land suitable for agricultural operations within the Dominion, much of it of unsurpassed fertility, will always enable Canada to furnish from her surplus food products of prime quality for the less favoured nations of Europe. But since cheap railway and water conveyance of agricultural productions from distant countries is rapidly affecting the economic aspects of agriculture in all parts of the world, it is of the utmost importance that those who are interested in the cultivation of the soil in Canada should strive to remedy all that is faulty or wasteful in practice, and by the introduction of new products and improved methods endeavour to maintain the position Canada has gained as a producer and exporter of farm produce. It having been demonstrated that agricultural experimental stations are of much service in supplying needed information and stimulating the progress of agriculture wherever they have been established, either in Europe or America, this important subject has engaged the attention of the Government of Canada. A bill was introduced last session by the Honourable the Minister of Agriculture, which was passed almost without opposition by the Parliament of the country, which provides for a system of experimental agriculture which is likely to meet the most pressing present needs of the farming community throughout the Dominion, and by judicious forethought and experiment will, it is hoped, anticipate the requirements of the future. The methods proposed are intended to secure for Canadian agriculture the greatest good at a comparatively small cost.

Organization and Management.

A central experimental farm has been secured near the capital, the dividing line between the important Provinces of Ontario and Quebec, comprising 465 acres of land, which will serve as an experimental station for these Provinces jointly. Here the climate represents the average condition of a large part of the settled portions of Canada, where all the cereals and many other field crops can be successfully grown, and where most of the best varieties of grapes grown in the open air ripen well, and many sorts of apple and other fruits are raised with advantage At this central point all the different classes of experimental work will be conducted. There will also be established one sub-station for the Provinces of Nova Scotia, New Brunswick and Prince Edward Island jointly, and one each for Manitoba, the North-West Territories, and British Columbia. In the Maritime Provinces and in British Columbia 200 acres will probably be sufficient for the purposes of each station, but in Manitoba and the North-West Territories, where land is abundant and cheap, there will probably not be less than a section of 640 acres belonging to each station, so that there may be land sufficient to carry on experiments in stock raising and forestry on such a scale as the circumstances of the case may require.

With the varying conditions of climate and soil necessarily associated with a stretch of territory covering 4,000 miles, from ocean to ocean, all now accessible by rail, a station on the Atlantic, another on the Pacific, with three intermediate ones, will be constantly required to carry on the work with reasonable efficiency. It is also expedient that the Government reserve, at suitable points in Manitoba and the North-West Territories, from the available and unoccupied Dominion lands, blocks of one, two, or more sections each, for future experimental work in tree planting. The setting apart of these blocks of land for forestry purposes will not in any case be a loss to the country, since if they should be planted only in part, this will increase the value of the remaining portion and also that of all the lands in the neighbourhood. By adding to the value of the adjacent lands these sections would partly pay for themselves, and at the same time prepare the way for extended experimental work if desired, as soon as young forest trees were available for the purpose.

The whole will be under the control of one head, known as Director, whose residence will be at the central station, and whose duty it will be to visit the sub-stations as occasion requires, and, in conference with the managers of such stations, arrange for the course and character of the work to be carried on at each, subject to the approval of the Minister of Agriculture. This arrangement will ensure desirable uniformity in the character of the work performed, and prevent the waste which might result from the unnecessary duplication of experiments.

At the central station there will be required, in addition to the Director, a superintendent of agriculture charged with the care of farm stock and dairy; also with field crops and field experiments.

A superintendent of horticulture, who will conduct experiments in fruit and vegetable growing, in determining the vitality and purity of seeds, and have charge of the nursery and propagating houses.

An entomologist, whose duty it will be to investigate the habits of insects destructive to farm and garden crops, fruit, &c, as well as those affecting animals, with the view of testing such remedies as may be available for their destruction. He will also prepare such collections for the museum at the central station as will illustrate the insects injurious and beneficial to vegetation, and duplicate collections of a similar character as early as practicable for each of the sub-stations.

A botanist, to whom will be entrusted the special duty of investigating the injury done to field and garden crops, fruit and forest trees, by the lower forms of vegetable life, such as fungi, rusts, moulds, &c.; to study the character and modes of growth of the noxious weeds prevailing in all parts of the Dominion, with the object of devising means for their subjugation or destruction. He will also take charge of the botanic garden or arboretum, and of that portion of the central museum illustrating vegetable products.

A chemist, to whom will be referred all questions relating to agricultural chemistry, such as analyses of fertilizers, the determination of the chemical constituents of any substances which it may be desirable to use in experimental work in feeding or for other purposes; to make analyses of milk in connection with experiments in dairying, of wheats, to determine their relative quality for milling; and to have charge of all other subjects requiring special chemical investigation in connection with the work being carried on at any of the stations.

Sub-Stations.

The officers required at each of the sub-stations will be a superintendent of agriculture and a superintendent of horticulture. The superintendent of agriculture to be the chief officer of the station, subordinate only to the Director, and responsible to him for the proper government of the farm, and for the due performance of all work directed to be undertaken. The superintendent of horticulture and all other employees will be subordinate to the superintendent of agriculture, and under his direction.

Reports.

The outlying stations will report to the Director as often as required, and the reports of the officers of all the stations will be presented through the Director to the Minister of Agriculture.

Nurseries and Propagating Houses.

At each station there will be established a nursery for the propagation of such varieties of plants, fruit, forest trees, &c., as may be desirable for the purpose of distribution, so as to rapidly extend the area of experimental work. Each station will also be provided with a propagating house to facilitate these objects and for the purpose of testing the vitality and purity of seeds for farmers and others.

Museum.

A general museum will be established in connection with the central station, where samples of all the varieties of produce raised from year to year will, as far as possible, be kept for reference and comparison, as well as for the instruction of visiting farmers. Specimens of injurious insects and their work, of injurious and beneficial birds, and other subjects of interest, will also find a place here.

Other Duties of Officers.

In addition to the special duties referred to, the officers of the several stations will be expected to visit, whenever practicable, the public meetings of the farmers and fruit growers in different parts of the Dominion, for the purpose of conferring with them, and aiding in the discussion of the many problems connected with agricultural and horticultural pursuits which may be discussed.

Disposal of Produce.

In the management of the stations all the products will be sold, and a strict account kept of the returns. No officer or employee will receive any portion of the produce without paying fair value for the same.

Grain Crops.

All cultivated cereals manifest, sooner or later, a tendency to deteriorate or run out; some much earlier than others. New varieties freshly introduced into a country often show great vigour and a high average of productiveness. Hence the importance of introducing new or untried sorts, and of the exchange of seed between localities having different conditions as to climate. Spring wheat has been for some years past a comparative failure in Ontario, producing, it is said of late, an average of 12 bushels, as against a former yield of nearly 20 bushels. This is attributed to various causes, such as climate changes, exhaustion of soil and insect pests. All these have some part in the result, yet it is likely that deterioration is an important element in the case. More knowledge as to the proper rotation of crops, more thorough tillage and thorough drainage, would materially aid in advancing productiveness.

When we consider that a single grain of wheat carefully grown as a separate plant will yield an average of about three hundredfold, and how small compared with this is the ordinary yield in field culture, it is evident that there is abundant room for experiment and improvement as to methods of cultivation and treatment. The results of some researches are of such a nature, that after definite conclusions have once been reached and published, there is no special need of their being repeated. Not so with the growth of agricultural products; the circumstances of climate and soil are so variable, and changes in the character of plants so frequent, that experiments may be constantly conducted with profit.

Recent researches in Russia, lately published in St. Petersburgh, demonstrate the fact that wheat grown in the northern provinces of that empire ripens in less time than that grown in the southern, the difference being about sixteen days. How much of this difference is due to variety has not been determined, but there is no question that if we succeed in obtaining for our vast wheat fields in the North-West earlier ripening varieties of good quality, the area of wheat culture will be extended, and the benefits resulting difficult to overestimate. Other field crops can, in all probability, in like manner be improved and made more profitable to the growers.

Stock, Horses, &c.

It is proposed to carry on a series of experiments with small herds of cattle, selecting such breeds as are likely to prove the most gene-

rally useful to the farmers residing in the provinces in which the several farms will be located. Experiments will be conducted for the purpose of ascertaining the value of different foods for fattening cattle, and for the production of milk, cheese, and butter. It is also intended to test the value of different breeds of horses, sheep, and pigs.

Dairy Products.

Since the general introduction of the factory system, cheese made in Canada has acquired an excellent reputation, owing to the uniformity of its character, and meets with a ready sale at fair prices; at the same time, the quantity exported has increased to a remarkable degree, but the exports of butter have not been so large, partly, it is said, owing to inferiority, being in most localities the product of individual and unskilled labour. Since Canada is one of the best countries in the world for dairying, butter should rank equal in quality and in demand with cheese. Evidence is not wanting to show that wherever creameries have been established the price of this product has been enhanced, in consequence of its uniformly good quality.

Experiments in this department would no doubt help to advance the butter interest.

Poultry and Eggs.

By reference to the statistics given of the exports of poultry and eggs, it will be seen that the egg trade has increased enormously, and will, on account of the constant and general use of eggs, admit of almost unlimited expansion. The results of experiments with different breeds of fowls, for the purpose of ascertaining their relative merits as egg layers and flesh producers, would be of great use to the agricultural community everywhere.

Fruits.

There is no question that most of our best varieties of small fruits will succeed in many of the northern townships of our older provinces, where they are, as yet, but little grown, and equally well in many localities in the North-West. From the experience gained regarding the growth of hardy Russian fruits in Iowa, it is highly probable that many of these could be successfully grown in the northern sections of the Dominion, not only apples, but pears, plums and cherries also. The early introduction of these fruits would be highly appreciated.

In the more favoured sections of the Dominion the variableness of the existing climate should be considered and some efforts made to prepare for changes which will probably occur, sooner or later, from the deforestation of the country.

The fruit trade of Canada is rapidly increasing. It is tenfold greater than it was a few years ago, and with a proper selection of late keeping sorts, and the more general introduction of fruit evaporators, the trade might be almost indefinitely extended.

Forestry.

The work to be undertaken in this department will include experiments in reclothing denuded land, testing the comparative value of our native trees, also of those from all other parts of the world, where similarity of climate or other circumstances render it probable that they will prove useful. It would also include the propagation of trees of economic value for general distribution.

Fertilizers.

The establishment of a chemical station in connection with the central experimental farm will provide the means of thoroughly testing and establishing the value as a fertilizer of Canadian mineral phosphates, and undoubtedly aid in developing this important industry. Ashes are shipped in large quantities from Canada to the United States, where they are sold as a fertilizer, at a cost of from 25 to 33 cents a bushel, while Canadian farmers hesitate to pay 10 cents per bushel. If the actual manurial value of ashes on farm and garden crops was demonstrated to our farmers, it is altogether probable that this useful article would be consumed at home.

The character of the work involved in the complete analysis of fertilizers is such as to require special forms of apparatus which are complex and expensive. Appliances of this character would be needed in the laboratory at the central station for the special work to be undertaken there; and when that department was properly equipped, all the work of this nature required for the Dominion could be efficiently and economically done there.

Injurious Insects.

Deficiencies in crops often arise from the depredations of insects. The yearly loss in Canada from this cause is very large, almost every farmer suffering to some extent. Such losses cannot be entirely prevented, but might be greatly lessened by the diffusion of

more general information on the subject. Were a skilled entomologist appointed, whose duty it would be to visit districts where insect plagues occur, and give all the information obtainable as to the best preventive and remedial measures to adopt, the annual losses might be greatly reduced.

Botanic Garden.

It has long been a reflection on Canadian taste and progress that we have no botanic garden in the Dominion. In Australia and India there are several such gardens supported by the Government. Botanic gardens have also been long established in Ceylon, the Mauritius, Jamaica, and several other of the West India Islands. Canada is, indeed, the only important British colony where such an instructive institution is wanting. In such gardens, trees are tested as to their hardiness, for the production of timber, for their bark for economic purposes, and for their fruit, and all sorts of medicinal and other flowering plants are grown. Such a garden it is proposed to establish in connection with the Central Experimental Farm, where all the native trees, shrubs and flowers of the Dominion can be brought together as far as conditions of climate will permit, and new and useful species introduced and propagated. This garden will be a very instructive feature in connection with the work and can be carried on there at a relatively small cost.

General Usefulness.

The agricultural experimental farms, properly conducted, will soon become bureaus of information for all who are concerned with agriculture or horticulture, which the farmer and fruit grower will be encouraged to visit, and inspect the work going on, and where it is hoped they will feel free to report regarding such difficulties as they may experience in the course of their work, and seek information from the officers in charge.

General Summary.

The following is a general summary of the work, which, it is proposed under the act, should be undertaken:

(*a*). Conduct researches and verify experiments designed to test the relative value, for all purposes, of different breeds of stock, and their adaptability to the varying climatic or other conditions which prevail in the several provinces and in the North-West Territories;

(*b*.) Examine into scientific and economic questions involved in the production of butter and cheese;

(*c.*) Test the merits, hardiness and adaptability of new or untried varieties of wheat or other cereals, and of field crops, grasses and forage plants, fruits, vegetables, plants and trees, and disseminate among persons engaged in farming, gardening or fruit growing, upon such conditions as are prescribed by the Minister of Agriculture, samples of such surplus products as are considered to be specially worthy of introduction;

(*d.*) Analyze fertilizers, whether natural or artificial, and conduct experiments with such fertilizers, in order to test their comparative value as applied to crops of different kinds;

(*e.*) Examine into the composition and digestibility of foods for domestic animals;

(*f.*) Conduct experiments in the planting of trees for timber and for shelter;

(*g.*) Examine into the diseases to which cultivated plants and trees are subject, and also into the ravages of destructive insects, and ascertain and test the most useful preventives and remedies to be used in each case;

(*h.*) Investigate the diseases to which domestic animals are subject;

(*i.*) Ascertain the vitality and purity of agricultural seeds; and

(*j.*) Conduct any other experiments and researches bearing upon the agricultural industry of Canada, which may be approved by the inister of Agriculture.

WM. SAUNDERS,
Director.

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CENTRAL EXPERIMENTAL FARM,

OTTAWA, CANADA.

BULLETIN No. 1.

FEBRUARY 12th, 1887.

To the Honourable the Minister of Agriculture:

Sir,

I have the honour to submit herewith the first Bulletin of the Central Experimental Farm for the year 1887.

During the short time which has elapsed since the establishment of this important section of the Department of Agriculture, much work of a preliminary character has been accomplished, many of the details of which will appear in subsequent Bulletins.

Under your instructions I have visited the Maritime Provinces also Manitoba, the North-West Territories and British Columbia, for the purpose of acquring such information as will aid in determining where the several Experimental Farms which are to be established may be located, so as to confer the greatest good on the greatest number of farmers in the Provinces and Territories referred to. I have also visited many districts in the Provinces of Ontario and Quebec, and availed myself of every opportunity which has presented of gaining information relating to the condition of agriculture as well as its special needs in these Provinces.

Trusting that this report of progress will meet with your approval, and also prove satisfactory to the farmers of Canada for whose special benefit this work is being undertaken.

I have the honour to be,
Your obedient servant,

WM. SAUNDERS, F.R.S.C., F.L.S., F.C.S.
Director.

Ottawa, February 10th, 1887.

CENTRAL EXPERIMENTAL FARM,

OTTAWA, CANADA.

INTRODUCTORY.

In presenting this first Bulletin of the series to be issued from the Experimental Farm for the information and guidance of all those who are interested in any of the departments of agricultural industry, it has been thought best to refer briefly to the circumstances which have led to the establishment of Experimental Farms in Canada, and to recite what classes of work it is proposed should be undertaken by these institutions.

During the session of the Dominion Parliament in 1884 a select committee was appointed by the House of Commons to enquire into the best means of encouraging and developing the agricultural interests of Canada. That committee took evidence and collected and published the opinions of a large number of practical men, most of whom favored the establishment of one or more Experimental Farms.

In November, 1885, shortly after the present Minister of Agriculture took office, the writer was instructed to visit as many of the Experimental Farms and Stations in the United States as might be necessary in order to gain information as to the benefits such institutions were conferring on practical agriculture, including stock raising, dairying, &c., and on horticulture, with special reference to the production of fruit. Also to enquire into the subject of forestry and all other useful phases of this work.

A report was prepared and submitted to the Minister of Agriculture on the 20th of February, 1886, containing the results of this enquiry, accompanied by an outline of a proposed system of experimental work, embracing those features which it was thought would be most particularly beneficial to the great agricultural interests of Canada.

During the session of Parliament for 1886 the Minister of Agriculture introduced "An Act respecting Experimental Farm Stations," which after a brief discussion was passed without opposition. This Act provides for the establishment of an experimental farm for the Provinces of Ontario and Quebec jointly, to be known as the principal or central farm, one for the Maritime Provinces jointly, one for the Province of Manitoba, one for the North-West Territories, and one for the Province of British Columbia. Provision was also made for the setting apart of several sections of land in Manitoba, the North-West Territories and British Columbia for the special purpose of tree planting and timber growing.

The work to be undertaken at the different stations is thus set forth in the Act:—

"(*a.*) Conduct researches and verify experiments designed to test the relative value for all purposes of different breeds of stock, and their adaptability to the varying climatic or other conditions which prevail in the several provinces and in the North-West Territories;

(*b.*) Examine into the economic questions involved in the production of butter and cheese;

(*c.*) Test the merits, hardiness and adaptability of new or untried varieties of wheat or other cereals, and of field crops, grasses and forage-plants, fruits, vegetables, plants and trees, and disseminate among persons engaged in farming, gardening or fruit growing, upon such conditions as are prescribed by the Minister, samples of the surplus of such products as are considered to be specially worthy of introduction;

(*d.*) Analyze fertilizers, whether natural or artificial, and conduct experiments with such fertilizers, in order to test their comparative value as applied to crops of different kinds;

(*e.*) Examine into the composition and digestibility of foods for domestic animals;

(*f.*) Conduct experiments in the planting of trees for timber and for shelter;

(*g.*) Examine into the diseases to which cultivated plants and trees are subject, and also into the ravages of destructive insects, and ascertain and test the most useful preventives and remedies to be used in each case;

(*h.*) Investigate the diseases to which domestic animals are subject;

(*i.*) Ascertain the vitallty and purity of agricultural seeds ; and

(*j.* Conduct any other experiments and researches bearing upon the agricultural industry of Canada, which are approved by the Minister."

The proposed establishment of these Experimental Farms in different Provinces of the Dominion has met with hearty expressions of approval from farmers everywhere, and has awakened a general interest in experimental agriculture to a degree never before manifested. Intelligent and thoughtful men realize that agriculture has always been an experimental branch of national industry, and that there will, during all future time, be associated with it important problems worthy of investigation. The progress of agriculture in the past has been mainly brought about by the experiments of practical farmers, many times repeated, and the results passed from one to another have eventually become common property. Knowledge accumulated in this laborious and fragmentary manner while exceedingly useful is often lacking in exactness while the relative value of the facts gained is not often accurately determined. The ordinary farmer has neither the appliances nor the time to conduct experiments of an exhaustive and precise nature, indeed with many the problem of subsistence is an important and all absorbing concern. Seeing that the world's supplies depend almost entirely on the world's crops, farming must always rank as the most essential of human pursuits, and should be aided and encouraged to the utmost. The important bearing of the crops on the prosperity of Canada is well understood, and any aid or stimulus given to increased production in this department will speedily be felt in all the avenues of commerce.

It is intended to make the Experimental Farms as generally useful to the farming community as possible and to undertake such courses of experiments in each province as may be most needed there. Constant effort will be made to ensure accurate results, and by careful repetition of the work undertaken to remove, as far as possible, every element of error, while the conclusions will be fully and honestly reported.

Work already accomplished.

The Central Experimental Farm has been located near the Capital, within three miles of the Parliament Buildings. Four hundred and sixty acres of land have been secured in a commanding position

overlooking the city of Ottawa, possessing every desirable variety of soil and aspect to meet the varied requirements of the experimental work to be conducted there. Although possession was had but a few days before winter set in, some work has been accomplished, unnecessary internal fences have been removed, the loose stone cleared over a large area, some grading done and about twenty acres of land ploughed. During the winter a large supply of stable manure has been obtained, between fifty and sixty acres of undergrowth chopped and piled, an office and store room erected, and a glass structure built for the purpose of testing the vitality and germinating power of seeds.

Correspondence has been had with the Directors of the Royal Gardens at Kew, England, the Imperial Botanic Garden at St. Petersburgh, Russia, and the Imperial College of Agriculture at Japan, and as a result collections of grain and seeds will shortly be received from these several institutions. Purchases of seed-grain in great variety, including wheat, barley, oats and rye, also grass seeds for meadows and permanent pastures have been made in Northern Russia, Germany, England, Canada and the United States with the view of testing their comparative merits when grown side by side. A collection of many varieties of potatoes has also been secured for a similar purpose. A large number of standard fruit trees and vines are being obtained; also a collection of hardy Russian sorts, comprising nearly two hundred varieties, some of which it is hoped will succeed in the colder sections of the Dominion where the more tender kinds cannot be successfully grown. A very extensive assortment of economic and other forest trees and shrubs, both native and foreign, are being secured; also collections of seeds of the same, for the further extension of this important division of the work. Plans of the necessary buildings are also being prepared, so that no delay may occur when the time arrives for their erection.

SEED TESTING.

This department is now ready for work. It has been undertaken for the purpose of determining the value of the agricultural seeds which are sold to farmers from year to year, and to save them from some of the losses to which they are annually subject by using old and inferior seeds. Every farmer in Canada will have the privilege

and the right to send to the Experimental Farm samples of any seeds of which he may desire to know the germinating power, and it is hoped that all will avail themselves freely of the advantage offered. A suitable glass structure has been erected for this work of a sufficient size to admit of the testing of a very large number of samples at one time.

Methods.

The returns of the germinating power of seeds will not be based upon a single test, but every sample will be tested in duplicate, once in the soil and again out of the soil in the most approved form of apparatus devised for this purpose. Small seeds will also be examined for impurities such as sand, dust, foreign seeds, chaff, &c., and the proportion of these given.

Directions for sending Samples.

The samples sent should be a fair average of the whole of the seed from which it is taken. The quantities which should be forwarded will vary in proportion to the size of the seed. Of large seeds such as corn, peas, wheat, barley, oats, &c., about four ounces will be required, while of the smaller seeds such as grass, clover, turnip, carrot, &c., from half an ounce to an ounce will be sufficient. The larger seeds may be put into small cotton bags each marked with the name of the seed, and these smaller bags enclosed in a larger canvas bag provided with a tag on which the address may be written. The smaller seeds may be folded in stout paper, each parcel marked and the whole enclosed in a strong envelope. Packages and communications should be addressed: "Experimental Farm, Ottawa, Canada." All mail matter will be carried free to and from the Experimental Farm within the limits of the general postal regulations as to the size and weight of packages. All seeds received will be entered in the order in which they arrive and the returns made as promptly as possible.

Treatment of Forest Tree Seeds.

The great importance of encouraging and stimulating tree planting among the farmers, especially in the Northwest Provinces, is beyond dispute. It is felt also that this can only be accomplished on the scale of magnitude required by the planting of suitable forest tree seeds, which can be gathered from the native trees growing in

the Provinces or purchased at a small cost. This leads us to add a few words of advice on the general treatment of forest tree seeds

Many of the tree seeds which mature early are better sown soon after they are gathered. This applies especially to the several varieties of elm and to the soft maple. The hard maple, box elder and ash seeds keep well over winter, provided they are stored in a cool place and not allowed to get too dry. Acorns, nuts and stone fruits are most successfully planted in the autumn, but if kept over winter should be mixed with moist sand and exposed to frost and planted as early as possible in the spring, taking care that they are at no time left in masses under conditions so as to heat. Many failures with seed arise from not sowing it in partial shade. If seeds are exposed alternately to hot sunshine and cold, while they are swelling, they will frequently rot before they appear above the surface. The requisite shade may be obtained by the use of brush wood, or a light layer of corn stalks or straw, removing this as soon as the seedlings are up and fairly established. Many nurserymen enclose their seedbeds with wooden frames, on which are laid light frames made of one-inch strips and covered with cotton or muslin. These are convenient and can be provided at small cost. Seedlings of evergreen trees grow slowly and require to be shaded and kept moist during hot weather all through the first year of their growth and sometimes longer. Seeds take some time to swell their coats after being placed in the ground, hence, if planted dry, they should be sown as soon as soil can be had to cover them. Germination may be hastened, especially with seeds of a hard texture, by pouring hot water on them and allowing them to soak for twenty-four hours before sowing.

Seeds sometimes fail to grow from being planted too deep. The larger nuts and acorns should be covered with soil about as deep as the seed is thick ; other smaller seeds should not be covered with more than half an inch of mellow soil, pressed gently with the back of a spade so as to make the earth firm around them, and when the young seedlings appear they should be carefully weeded. Occasionally seeds will remain in the ground until the following season without germinating. Should any fail to grow by the time spring is over, and on examination the kernels are found sound, the seedbeds should be kept weeded and shaded until the next season.

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CENTRAL EXPERIMENTAL FARM,

DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - - CANADA.

BULLETIN No. 2.

DECEMBER 15th, 1887.

To the Honourable the Minister of Agriculture:

Sir,

I have the honour to submit herewith, for your approval, the second bulletin of the Central Experimental Farm, in which will be found some details of the more important features of the work which has been undertaken in agriculture, horticulture and forestry since the issue of bulletin No. 1. Owing to a lengthened absence in the Maritime Provinces and in the North-West and British Columbia, the issue of this bulletin has been unavoidably delayed. Hoping that the marked progress made at the Central Experimental Farm will be so far satisfactory to you as to gain your approbation,

I have the honour to be,

Your obedient servant,

WM. SAUNDERS,
Director.

Ottawa, December 15th, 1887.

Central Experimental Farm,

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DEPARTMENT OF AGRICULTURE, OTTAWA, CANADA.

TESTING THE VITALITY OF SEEDS.

In the first bulletin issued from the Central Experimental Farm in February last, an invitation was extended to farmers, gardeners, horticulturists and others, interested in the quality and purity of agricultural seeds to send samples to the farm to be tested as to their vitality and germinating power. In response to this request 187 packages of seeds were received during the months of March and April, coming from many different sections of the Dominion, but the larger proportion of them from Ontario and Manitoba.

These seeds were found to vary as to their vitality, some being nearly perfect in this respect, while others were worthless from the loss of all their germinating power. The specimens of grain sent from Manitoba and the North-West Territories showed a higher average of vitality than those from the Eastern Provinces of the Dominion, an indication of the correctness of the opinion generally held, that grain grown in Northern countries possesses more vigour and vitality than that produced in more Southern latitudes, which makes it more valuable for seed. Comparing Manitoba and the North-West Territories with Ontario and the Provinces east, the few tests thus far made show the following averages :—

	North-West Provinces. Proportion of Vitality.	Eastern Provinces. Proportion of Vitality.
Wheat............	96 per cent.	92
Barley............	97 "	73
Oats...............	95 "	65

It is proposed to undertake a much larger number of tests during the coming season, and in subsequent years, for the purpose of ascertaining whether these differences are normal and within what limits they vary.

The following table has been prepared to show the number of tests made of each sort, the highest and lowest degrees of vitality, as well as the average in each case:—

	No. of tests.	Highest vitality.	Lowest vitality.	Average vitality.
Wheat	37	99	36	88
Barley	17	99	34	91
Oats	14	99	52	85
Corn	14	100	22	86
Peas	4	94	38	78
Timothy	4	97	89	94
Other Grass Seeds	12	89	00	42
Clover	6	95	70	83
Turnip	9	97	58	81
Mangold	11	97	39	74
Carrot	11	78	12	50
Cabbage	8	93	16	64
Beet	5	98	63	79
Tomato	5	72	44	61
Onion	5	80	28	59
Flax Seed	3	95	81	86
Parsnip	3	50	24	33
Radish	2	40	19	29½
Miscellaneous Seeds	17			
	187			

The miscellaneous seeds included one sample each of Rye, vitality 90 per cent.; Rape seed, 98; Buckwheat, 80; Beans, 68; Celery, 10; Cauliflower, 48; Cucumber, 36; Lettuce, 65; Cress, 15; Sage, 23; Spinach, 8; Summer Savory, 10; Sweet Marjoram, 17, and Maple tree seed from British Columbia (*Acer macrophyllum*) 40 per cent. Also two samples of Melon seed and one of Squash, both of which entirely failed; these were said to be ten years old, and were supposed by the party sending them to be gaining in vitality by being kept.

Some very useful and practical results were reached by these tests, of which the following will serve as examples:—

A dealer in agricultural seeds, for whom some tests were made, writes thus: "Thanks for your careful report on seeds sent for testing; it will ensure the destruction of all of low average growth and thus directly benefit the people for whom the Experimental Farm was established."

A handsome sample of Cream Egyptian Oats, held for seed, was sent from Nova Scotia. These oats were plump and heavy, weighed about forty pounds to the bushel, and appeared to be in good condition. On being tested they showed a germinating power of only forty-seven per cent; the blades were weak and sickly, showing that the oats were quite unfit for seed. These had probably been injured in the mow by being taken in before they were thoroughly cured.

A sample was received from a lot of 125 bushels of garden peas grown for seed, which it was suspected had been injured in harvesting, on testing them they were found to have lost much of their vitality, only thirty-eight per cent sprouted.

There exists in the minds of some farmers a prejudice against the use of corn for seed, which has been stacked out all winter, many asserting that it will not grow. A sample sent by a correspondent to test this point showed a vitality of eighty-five per cent., which was about the average quality of the samples received.

Last season the house for seed testing was not completed until February, which made the time for work very short, and many did not hear of the advantages offered until it was too late to avail themselves of them. Seed testing for next season's sowing has already begun and will be continued throughout the winter. It is hoped that many will avail themselves of this opportunity and send their samples early. No charge is made for testing and samples addressed to the Central Experimental Farm, Department of Agriculture, Ottawa, pass free through the mail. The time occupied by each test is from ten to twenty days; the quantity of seed required will vary with the size of the individual grains, not less than 250 to 300 seeds should be sent.

IMPORTATION OF SEED GRAIN.

Early in the winter of 1886, correspondence was opened with reliable dealers in seed grain in England, Germany, France and

Northern Russia, with the view of securing a large number of varieties for comparative test. Wheat was sought from Northern Russia with the hope of obtaining a hard wheat of good quality, equal if possible to the Red Fife, so much esteemed, with an earlier ripening habit, so as to lessen the loss which early frost sometimes entails on the vast wheat crops of Manitoba and the North-West Territories. A large number of varieties of wheat, oats and barley, were obtained in Germany, England and France, gathered from all quarters of the world, for testing on the Experimental Farm at Ottawa, and one consignment of wheat from Riga, Russia, intended principally for distribution among the farmers in the more northern sections of the Dominion.

This wheat as received was of excellent quality, plump and hard, weighing sixty-one pounds to the bushel, and, when submitted to experts, was said to grade "No. 1, hard." There were distributed through the mail 667 sample bags of this grain, each weighing about three pounds; 277 of these were sent to Manitoba and the North-West Territories, and the remainder to the other Provinces, so that the value and period of ripening of this wheat might be ascertained under many varying conditions. Among the farmers in the Eastern Provinces some Manitoba seed-wheat of excellent quality was similarly distributed, which increased the number of samples sent out for trial to 1,149. Besides this there were sent to the Commissioner of Indian Affairs, Lieut.-Gov. Dewdney, about 1,200 pounds of the wheat from Northern Russia to be distributed among the Indian agencies, to be grown on their reserves, a portion also was kept to be sown on the Experimental Farm at Ottawa.

A copy of the following circular was sent with each sample of the Russian wheat:

"CENTRAL EXPERIMENTAL FARM,

"DEPARTMENT OF AGRICULTURE,

"*Ottawa, 1887.*

"DEAR SIR,—There has been sent to you this day by mail from the Central Experimental Farm, a sample bag of Spring wheat, which has been obtained under instruction of the Minister of Agriculture, from one of the Northern Provinces of Russia. This wheat has been ripened above latitude 56, more than 600 miles further north than the City of Ottawa, where the summer

season is very short; hence it is expected that it will ripen in Canada earlier than any of the varieties now in cultivation.

"You will oblige by testing this wheat and returning at the close of the season to the Central Experimental Farm, Department of Agriculture, Ottawa, by mail, in the bag herewith sent, a sample of the same as grown on your land, also state the character of the soil on which it was grown, the date of sowing, the time of ripening and the yield, with any other remarks relating to it which you may believe to be of importance. Tested at the seed house at the Experimental Farm, both in the soil and in the seed tester, this grain has produced a vigorous growth, 98 per cent. germinating promptly.

"WM. SAUNDERS,

"*Director.*"

Only part of the returns have as yet been received, but as far as they have come in, they show a most gratifying success, establishing the fact that this wheat will ripen in Manitoba and the North-West from ten to fifteen days earlier than Red Fife, a gain which past experience would lead us to believe would be sufficient to secure this most important crop from all danger of frost. The shipment from Russia was not received until the seeding season in the North-West was nearly over, hence the wheat could not be sown early enough to give it a favourable chance; on this account it will require the experience of another year to establish with accuracy its period of ripening. This subject is of such vast importance to the future of the country that no pains will be spared in the endeavour to ascertain the true bearing of all the facts. Samples of this wheat as grown in the several Provinces are being submitted to eminent experts for their opinion as to its quality, it is also undergoing careful chemical analysis with other wheats for comparison, and if practicable a portion will be ground into flour and its value in bread making tested; a special bulletin on the subject will be issued as soon as all the desired information is available.

In the meantime the interest awakened in the subject in the North-West is very great, and so large a number of applications have been sent in for samples for spring planting, that a second consignment has been ordered from Riga, which supplemented by what has been grown here will, it is hoped, be sufficient to introduce this wheat into almost every locality and prepare the way for its general cultivation within two or three years.

The Manitoba wheat distributed consisted of Red Fife, White Fife and White Russian, all good samples. These were sent mainly to farmers in Ontario and Quebec, with the view of ascertaining whether seed wheat obtained from the north would manifest unusual vigour and fertility. The season in these Provinces has been so unfavourable that no very reliable data is likely to be obtained this year.

SPRING WORK.

On the second of May the ground was sufficiently free from frost to permit of work being begun on the Central Experimental Farm. The removal of internal fences, the gathering up of stone and the removal of stumps, necessarily delayed and limited other operations.

Ploughing was begun on the 2nd and seeding on the 6th of May. Many acres were brought under cultivation and seeding and planting were continued until the season was quite advanced.

GRAIN TESTING.

Sixty-seven varieties of spring wheat were sown, a large proportion of which were obtained from Europe, some from Russia, France, England, Hungary, Greece, Italy and Germany, also several from India, New Zealand, Australia, Japan, and others from the United States. Many samples were kindly donated by Prof. Lazenby of the Ohio Experiment Station at Columbus, and some by Prof. Brown of the Ontario College of Agriculture, Guelph. Owing to the great drought which prevailed this year during the growing period, the results have not been entirely satisfactory and another year's testing will be needed before the relative value of these varieties can be determined. Among the promising sorts the following deserve special mention: Pringle's Champlain, Improved Summer Cob, White Delhi, Californian White, Trimenia Sicilian Bearded, Galician Summer, Indian Hard Calcutta, Hungarian Mountain, Russian Hard Tag, Bearded Summer and Bearded March.

Thirty-one varieties of Barley have also been grown, among which the following are of much promise: Scholey's Chevalier, Hallet's Pedigree Chevalier, Swedish, English Malting, Danish, Californian, Screened French, Bestehorn's and Golden Melon. The Six-rowed Mandschurian and Large Two-rowed Naked are among the heaviest yielders.

Of oats sixty varieties have been tested, the most promising of which of the white sorts are: Scotch Angus, Tartarian White,

August White, Swedish, Egyptian, Waterloo, Australian, Hungarian White, Scotch Berwick and Georgia Early White, and among the black varieties Longfellow, Hallets's Pedigree Black Tartarian.

A large proportion of these varieties of grain were obtained in small quantities, and grown in plots of 20 by 40 feet; about thirty sorts were grown in one-fifth acre plots and the remainder in larger quantities.

POTATOES.

Two hundred and forty-five varieties of potatoes were also obtained, chiefly from Europe, but most of them in small quantities only. The most promising productive sorts among the newer introductions are August Kidney, White Star, Emperor William, Queen of Potatoes, Manhattan, Jackson's Improved, Niagara, Ganea, Paterson's Napoleon, Crimson Garnet, King's White Kidney, Erfurt Incomparable, Sugar and Giant. A very promising seedling originated by Mr. Thos. A. Sharpe, of Wakopa, Manitoba, was also tested, and proved to be an excellent cropper. As the yield from the small quantities of seed obtained was necessarily limited, it has been thought best to save the whole crop for seed and leave the question of quality for consideration next year, when the varieties composing this large collection can be more fully reported on.

OTHER FIELD CROPS.

That portion of the farm which had been seeded down to timothy and clover yielded a very good crop of hay, amounting in all to over 145 tons. Of the standard varieties of potatoes such as Early Rose, Beauty of Hebron and Chicago Market, very fair crops were obtained; the same may be said of the carrots, mangolds and turnips grown for stock. Several acres of peas of the variety known as the Golden Vine also yielded well.

None of the land could be got into fit condition for experiments with grasses or with fertilizers until it was too late in the season to undertake such work. It is proposed to carry on experiments in this direction during 1888.

HORTICULTURE.

Since the climate of Ottawa is very fairly representative of the larger part of Quebec and Ontario, it is of much importance that the fruit-growing capabilities of the district be ascertained as early and as fully as possible. With this end in view an extensive collection

of both large and small fruits has been brought together, special attention having been paid to those varieties which are likely to be very hardy, including all those of Russian origin which could be obtained, as the climate on account of its severity here, has hitherto been regarded as unfavourable for the growth of most kinds of fruits.

LARGE FRUITS.

The collection comprises 903 apple trees of 297 varieties, of which 174 are Russian sorts; 298 pear trees of 101 varieties, 45 of which are Russian; 197 plum trees of 72 varieties, 32 of which are Russian; 155 cherry trees of 71 varieties, 54 of which are from Russia and other parts of Northern Europe; 25 Peach trees of 11 varieties, American; 7 Apricots of 4 varieties, 2 Chinese and 2 European; and 26 crab apple trees of 12 varieties, chiefly American.

SMALL FRUITS.

The collection of small fruits includes 891 hardy grape vines of 127 varieties, 865 currant bushes, comprising 20 varieties of the standard named sorts, to which must be added nearly 100 new seedlings, some of which are very promising. In the collection of 251 gooseberries there are 30 named sorts and about 50 unnamed seedlings. The 3,650 raspberries are represented by 38 named varieties and about 200 unnamed seedlings, among them are many interesting hybrids, some of which, from this season's showing, give promise of great fertility. Among the 509 blackberry plants there are 20 named varieties, including all the hardier sorts obtainable, and in the strawberry beds there are 20,900 plants of 90 named sorts and about 50 unnamed seedlings, forming a collection of much interest and promise.

FORESTRY.

Eighty-eight thousand young forest trees and ornamental shrubs have been procured and planted, comprising both evergreen and deciduous sorts, including many native and foreign species. The total number of species and varieties exceeds 500, among which are many never before introduced into Canada; this collection will be largely augmented by the product of the seed beds. It is intended that such sorts as prove hardy shall be propagated for testing in other parts of the Dominion.

SEED DEPARTMENT.

The seed beds consist of 278 frames, twelve feet long and four feet wide, in which there has been sown a large collection of the seeds

of trees, shrubs and plants. 335 packages were kindly sent from the Royal Gardens at Kew, London, England, a donation from the Director, W. J. Thistleton Dyer, Esq. This collection consisted almost entirely of ornamental shrubs and forest trees, many of them rare and valuable, from which it is expected that a large quantity of choice material will be obtained for future planting. Similar liberality has been shown by the Director of the Imperial Botanic Garden of St. Petersburg, Russia, Dr. E. Regel, who has sent 300 packages, about 100 of which were sent direct, the remainder to Mr. Chas. Gibb, of Abbotsford, Quebec, who very generously gave them to the Experimental Farm. In this assortment there were a large proportion of herbaceous and succulent plants from the Northern regions of Europe, with seeds of a number of species of shrubs and trees from Turkestan and Siberia. Through the kindness of Prof. C. Sassaki, Director of the Botanic Garden of the Imperial College of Agriculture at Tokio, Japan, 110 sorts have been obtained from that interesting country. In the Japanese collection there were forty species of trees and shrubs from the most Northern Provinces of the Empire, where the temperature is severe and the snow fall heavy during the winter months. It is probable that some of these will prove hardy in this country. Besides these about 1,200 sorts have been secured by purchase in Europe and America. Seeds from native Canadian forest trees and shrubs have also been planted in considerable quantities, gathered in Ontario and Quebec, while smaller collections have been obtained from the North-West Territories, British Columbia and other parts of the Dominion. A fair proportion of the seeds planted have started and made good growth, but as there are many sorts which remain over a year in the soil before germinating, most of the seed beds will be left undisturbed until the close of another season.

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CENTRAL EXPERIMENTAL FARM,

DEPARTMENT OF AGRICULTURE.

OTTAWA, - - - - CANADA.

BULLETIN No. 3.

MARCH 15th, 1888.

To the Honourable the Minister of Agriculture:

Sir,

I have the honour to submit herewith the third Bulletin of the Central Experimental Farm. This has been prepared at my request by Mr. James Fletcher, the Entomologist and Botanist of the Dominion Experimental Farms, and relates to the "Smuts affecting Wheat," a subject of much importance to farmers in every Province of this Dominion. The annual loss to the grain growers of Canada, caused by these several species of smut is very large, and as this loss may be easily prevented I have thought it desirable that this matter should be brought early and prominently under the notice of the farmers of this country, that the fullest information regarding the life history of these parasitic fungi should be presented together with such useful remedies as can be cheaply got and easily applied. In many parts of the North West the "bunt" smut is very prevalent, and in this instance the injury sustained is not alone the loss of the infected grain—itself a considerable item—but as this fetid smut is carried with the grain to the threshing machine and is there scattered throughout the mass of the wheat, the entire crop is depreciated in value and in some instances acquires so strong and unpleasant an odour as to become quite unsaleable for milling purposes.

As the time for sowing is now approaching, it is hoped that every farmer who has the slightest reason to suspect that his seed grain may be contaminated with the germs of either of these destructive parasites will treat it in accordance with the directions given in the latter part of this Bulletin under the head of "remedies." If this is generally done a great saving will be effected to the country and much after disappointment prevented.

I have the honour to be,

Your obedient servant,

WM. SAUNDERS,

Director.

Ottawa, March 15th, 1888.

Central Experimental Farm.

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DEPARTMENT OF AGRICULTURE

OTTAWA, - - CANADA.

SMUTS AFFECTING WHEAT.

BY JAMES FLETCHER, F.R.S.C., F.L.S.

Entomologist and Botanist to the Dominion Experimental Farms.

The large amount of loss to the wheat crop every year, from the attacks of the low forms of vegetable life known as Parasitic Fungi, is now universally acknowledged; but the enormous extent of this injury is only appreciated by those who specially turn their attention to the matter. For an evidence of the magnitude of this injury we may consult the Report of the United States Commissioner of Agriculture for 1886, where we find the following words: "we may safely assume that the value of the corn and wheat annually destroyed in this country by diseases induced by fungi is not less than \$200,000,000." This large sum of course also includes the injury caused by "Rusts" and "Mildews" as well as "Smuts."

Fungi is a Latin word (plural of *Fungus*) which is applied to a large class of flowerless plants of which Toadstools, Mushrooms and the large ear-shaped woody growths, sometimes found on forest trees, are conspicuous examples. There are, however, also included in this class many small forms which are not so readily recognized by the ordinary observer as fungi. Amongst these we find the "Moulds" which appear upon provisions when left in a warm and damp atmosphere, and also the "Smuts," "Mildews" and "Rusts" which are the chief agents in inflicting the heavy losses in grain and fruit crops already referred to.

Fungi differ very much from the ordinary forms of vegetation around us. They have neither true roots, stems, leaves, flowers, nor seeds. They are, however, unmistakeably plants, of low organization it is true, but still plants developed from germs called *spores*, somewhat analogous to, but not the same as, the seeds of the more highly organized flowering plants. A spore is a reproductive body which answers the same purpose as a seed by providing for the perpetuity of the species of plant which produces it; but has not like the true seed, a rudimentary plant already formed within it. The processes of development, fertilization and reproduction amongst these low forms of vegetable life, are as yet, with few exceptions, little understood. This is chiefly due to the difficulties attending their investigation, the very minute size of their parts, and the small number of students who have made a special study of this branch of science. We know, however, amongst other facts, that in all fungi we may recognize two systems, the first, vegetative, which is popularly called the "spawn" (*mycelium*) and which in those kinds parasitic upon crops, rob the plants cultivated of the nourishment necessary for them to produce the most satisfactory results; the second, reproductive, by which the injurious parasite is propagated.

My object in writing these lines is to remind farmers of the serious loss suffered every year from the ravages of one class of these parasitic fungi called "Wheat Smuts," and at the same time to draw their attention to some of the remedies which have been found successful in keeping these parasites within bounds.

It was at one time considered that the difficulties in the way of investigating these parasites were insurmountable, and that it was useless to search for remedies against their attacks. Now, however, sufficient has been discovered to show that there is a wide and fertile field for useful research with great promise of good results. To those who have not time nor opportunities for undertaking these highly interesting but difficult observations, I would earnestly recommend a little book entitled "Diseases of Field and Garden Crops" by Worthington G. Smith, (Macmillan & Co., London, 1884). In this small work of which I have made extensive use in this article, the author has treated of the chief diseases which attack crops, in a plain and simple manner, intelligible to all.

Figs 1 to 3 and 6 to 7 drawn from nature by Mr. Smith are through the courtesy of the publishers taken therefrom. For Figs. 4 and 5, also by the same talented artist, I am indebted to Messrs Edward Webb & Sons, The Queen's Seedmen, Wordsley, Stourbridge, England, who kindly presented me with electrotypes of those excellent figures for this bulletin.

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HARD SMUT, BUNT, STINKING SMUT, SMUT BALLS,

Tilletia caries, (Tul.) AND *T. lævis*, (J. Kuehn).

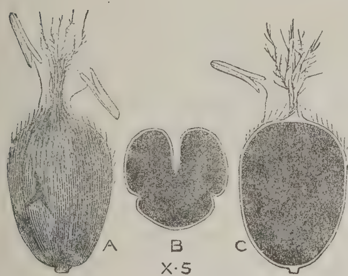

Fig. 1.

A. A "Bunted" grain of wheat.
B. A transverse section of same.
C. A longitudinal section.
(All enlarged 5 diameters)

The diseases of wheat known generally in North America under the name of "Bunt," "Hard Smut," or one of the other designations mentioned above, are due to the ravages of two parasitic fungi belonging to the family *Tilletia*. At Fig. 1, we have a representation of a "Bunted" kernel of wheat in which the whole of the farinaceous contents of the grain have been destroyed by the invading fungus and their place filled by a black powdery dust—the ripe spores of its reproductive system—sometimes called the fruit.

The family to which these parasites belong, was named after a French botanist Matthieu Tillet, who wrote a treatise on the smut diseases of wheat in 1755. *Caries*, the specific name of the commonest kind of Hard Smut in Europe, and which may also cause trouble in Canada, signifies, rotten, and is applied to it on account of the unpleasant odour given out when diseased grains of wheat are crushed. Both of the species mentioned above have at different times received names on account of this ill-odour. *T. caries*, (Tul.) was described by one author as *Uredo fœtida*, and *T. lævis*. (J. Kuehn) once received the very similar title of *Ustilago fœtens*, as I

am informed by Prof. W. G. Farlow, of Harvard University, who kindly identified for me specimens of that species received from the North West Territories. The fetid odour is a character which renders these diseases particularly pernicious; for not only does the farmer lose by their ravages a large percentage of the grain produced, but the strong odour of the spores is imparted to the whole crop reaped, and the sound grain is thus reduced in value to the extent, frequently of from 15c. to 20c. per bushel, by having this easily detected "stinking smut" amongst it. Sometimes instances have come under my notice where the whole crop was rendered commercially useless.

Whilst wheat is growing it is very difficult to detect the presence of Bunt; for although the vegetative system of the fungus permeates the whole substance of the wheat-plant attacked, as will be explained further on, it is only in the young kernel of wheat, which is hidden by the chaff, that the characteristic black spores are produced. When wheat-grains have been destroyed by Hard Smut they present an unusual external appearance, which is characteristic of the disease. They are shorter and more swollen (Fig. 1) than in healthy seeds, and from the dark contents showing through the thin skin, are of a dull, greenish-drab colour. They are frequently cracked, as shown at A, when some of the black powdery spores emerge. The figures given herewith show the successive stages in the life-history of *T. caries*, to which it is probable those of *T. lævis*, the commoner North American form, are very similar. If some of these spores be placed under a microscope and highly magnified, to 400 diameters, they will present the appearance shown at Fig. 2.

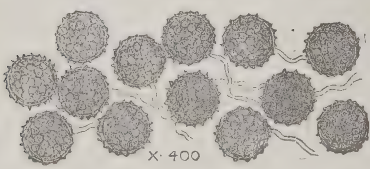

Fig. 2.

These spores, although apparently so large in the illustration, are in reality so exceedingly small that a single kernel of diseased wheat, it is said, will contain four millions of them. The threads shown in the figure amongst these spores are portions of the spawn or vegetative system of the fungus upon which they were produced. The outer coat of the spores presents, as shown in the illustration, a beautiful netted appearance, which, however, is wanting in *T. lævis* where, as the name indicates, the spores are quite smooth.

The germination of the spores and the production of the complete plant therefrom is much more complicated than is the growth of a flowering plant from its seed. It will be found that if one of these spores be examined after it has been kept upon a wet surface for three or four days that it has germinated as shown at Fig. 3 A.

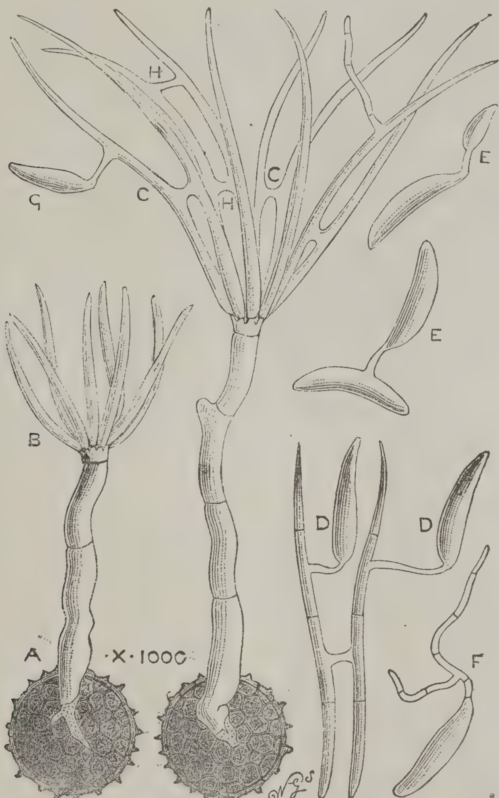

Fig. 3.

This figure is still more highly magnified, being enlarged 1000 diameters. At the point A we see that the outer skin of the spore has burst and a thick jointed tube is protruded. After a time on the end of this tube appear 8 or 10 small protuberances, and upon these again are produced elongated reproductive organs (B). These

bodies although necessary organs of reproduction do not bear the same analogy to the seeds of flowering plants as do the perfect spores (or fruit-spores). They partake more of the character of buds or the small bulblets found upon some plants. They are indeed spores, but are of an inferior class to the perfect spores shown at A, with which we began our examination. By Dr. M. C. Cooke these organs are termed "Sporules of the First Generation," when fully grown they come together and fusion takes place, two or sometimes three becoming united as at C and H by means of short tubes. After this, these conjugated bodies drop from the supporting tube and germinating produce upon short stems other reproductive organs of a different form (D) the "Sporules of the Second Generation." These latter are occasionally produced before the Sporules of the First Generation have dropped from the supporting tube (G), ultimately the Sporules of the Second Generation (D) fall from their attachment and germinating produce similar bodies to themselves, the "Sporules of the Third Generation" (E). When these last named germinate they produce the "Spawn" (*mycelium*) an exceedingly slender jointed thread which ultimately bears the perfect spores. This, however, is not until it has gained admission to its host plant and has forced its way up to the forming seeds.

The ripe spores will not grow as long as they are kept dry, as when stored away with seed-wheat, when however this is sown, they are carried with it into the damp soil, when all the changes illustrated in Fig. 3 take place. It must be remembered, however, that all so far related occurs in and on the soil. After the Sporules of the Third Generation have germinated and the slender thread-like Spawn is produced this grows rapidly and branches in every direction until it comes into contact with a young wheat plant. It now changes its nature and its parasitic life begins. It readily finds its way into the tissues of its host, and running up the stem chiefly through the intercellular spaces, at length reaches the seeds contained in the ear. Fructification now takes place and the spores are produced upon numerous small branches.

These spore-bearing branches are thicker and more gelatinous than those of the ordinary spawn and the spores are formed on little branches which are produced laterally. The spores become free by the drying up of the attaching foot-stalks.

This sketch of the life-history of this parasite from the spore to the perfect state where the spores are again reproduced, is the usual method in which it goes through its different stages. Under certain circumstances, however, which frequently occur, variations may take place at any point in its life-history.

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SMUT, LOOSE SMUT, DUST-BRAND.
(*Ustilago carbo*, Tul.)

Fig. 4.

"Smut," or as it is generally called "Loose Smut," to distinguish it from Bunt or Hard Smut to which it is distantly related, is very injurious to wheat, barley and especially oats, in many parts of Canada. The general appearance as represented at Fig. 4 is too well known. The scientific name *Ustilago* is derived from the Latin word *ustus*, burnt, and the specific name *carbo* means charcoal. Both names refer to the appearance of the spore masses when they are produced in the ear. This disease is not of the same serious nature as Hard Smut, from the fact that the smutted ears are easily observed and can with a little labour be all removed and destroyed before many of the spores are disseminated, and because there being no fetid odour emitted by the spores they do not spoil either the crop of wheat amongst which they grew, or the flour made therefrom.

As with Bunt so with this Loose Smut, it is evident that the disease begins at the bottom and works upwards. Our illustration (Fig. 4) shows us that the lowest spikelets were first attacked, and this is always the case. In all instances when the spores appear in the injured ears the spawn may be detected in every part of the plant from the root through the stem to the inflorescence. In no case, however, can this spawn be found in parts through which it is not necessary for it to pass in order to reach the point where the spores are formed, thus they are not found in the blades of the leaves. This smut is not restricted like Bunt to the seeds alone, but

the whole ear is destroyed. At D (Fig. 5) is shown a spikelet of

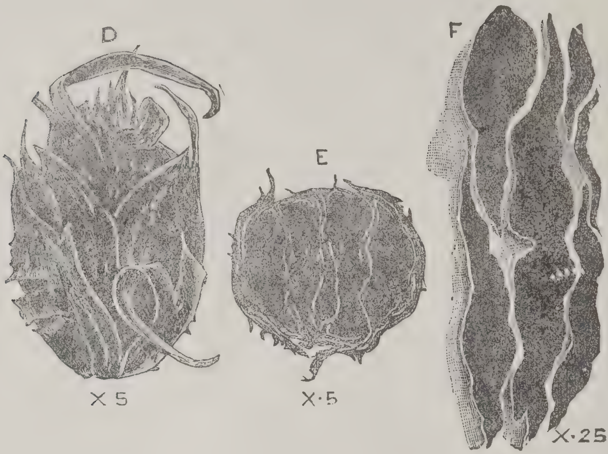

Fig. 5.

wheat including the chaff, which has been destroyed by smut, and at E. we have a transverse section of the same. Here we see that the entire tissues of the spikelet have been destroyed by the infesting fungus. If one of the injured scales of chaff be examined under the microscope it will be found to present the appearance shown at F, where the fungus has burst through the epidermis and brought to light enormous numbers of extremely small spores. These are much smaller than those of Bunt. For comparison they are shown at Fig. 6 magnified to exactly the same extent (400 diameters) as the spores of Bunt shown at Fig. 2.

Fig. 6.

The germination and development of these spores differs somewhat from those of Bunt. At Fig. 7, the different stages of germination are illustrated. These are enlarged to the same degree (1000 diameters) as in the case of Bunt at Fig. 3. When germination takes place a germ tube is produced as at 1. From this are given off as germination advances reproductive organs analogous to buds (2 A.A.), which are the Sporules of the First Generation. These

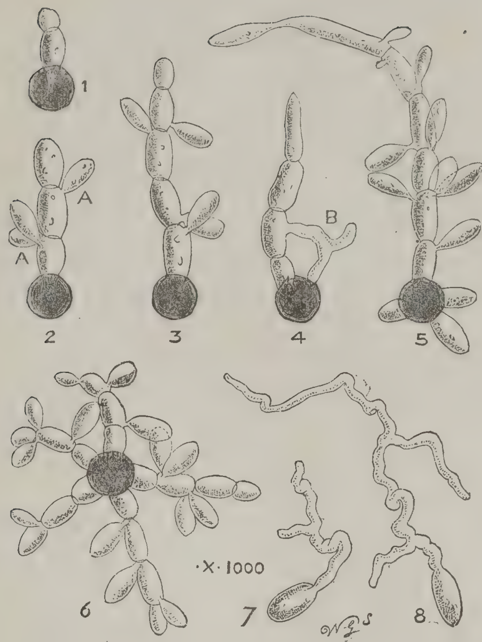

Fig. 7.

come into contact with similar sporules and a conjugation takes place of the same nature as that of the Sporules of the First Generation in Bunt (Fig. 3 C.C.), still further growth is shown at 5 and 6. When long germ-tubes are produced, as at 5, they commonly fuse with other germ-tubes, and then a common sporule-bearing tube is produced bearing the Sporules of the Second Generation. This tube is sometimes extremely long and fine and furnished with numerous joints. The sporules as produced by these germ-tubes are capable of producing others by budding, till at last large colonies are formed separate from the original spore. The last formed sporules, which are very unequal in size, under favourable conditions germinate as at 7 and 8. when the spawn is formed; this now follows the same course as that described under Bunt.

Now all these facts, interesting as they may be, have little practical bearing unless we can draw from them something which may direct

us where to look for a remedy. This, however, they do. Everything seems to point to the infection coming from the ground and travelling upwards. The disease always shows itself on the lowest spikelets of an ear of wheat or panicle of oats. It will always be found, too, that every stem upon an infested plant will show the disease, whilst others in close proximity will show no sign of it.

Mr. Smith in the book before referred to says, at p. 252: "It is easy to prove that Bunt in wheat is propagated by the spores of fungus, for if wheat seeds are dusted with the spores or watered with water containing spores, every wheat plant will come up bunted, whereas neighbouring plants, if not so treated, will come up free from disease."

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REMEDIES.

The nature and life-history of these smut fungi being, as above shown, comparatively well known, some practical remedies have been devised. That some of these remedies have had a decided effect upon the prevalence of the diseases in question is evident. Many instances have been brought under my notice where fields of wheat grown from treated seed have produced crops of perfectly clean grain, whilst close along side of them the crop reaped from seed not so protected was materially reduced by the ravages of these parasites. In Cooke and Berkeley's "Fungi, their Nature, Influence and Uses" p. 225, we find :—"Bunt is another pest which occupies "the whole farinaceous portion of the grains of wheat. Since dress- "ing the seed-wheat has been so widely adopted in this country *, "this pest has been of comparatively little trouble."

In the Report of the Botanist to the New York Agricultural Experiment Station for 1886 (p. 129), in an account of experiments made by Mr. C. S. Plumb, with different remedies for smut in oats, we find as follows :—"In every one of the ten experiments the testimony is "positive in demonstrating that good has resulted from the treatment "of the seed."

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* England.

All grain for seed should, of course, be procured as free as possible from smut; but when there is the slightest doubt about its presence, the trouble and expense of treating the seed are so small that there is no excuse for not doing so.

The condition in which the smuts pass the winter, is in the shape of the minute black spores produced in the ears of wheat. These spores either adhere to the ripe grain of adjacent wheat plants, or falling to the ground remain there, in an undeveloped condition, until the young wheat plant has attained the proper growth for them to begin their attack. By a proper system of rotation of crops, wheat would not be grown again on the same land for about 4 or 5 years, or more, and by this time it is probable that most of the spores from smut upon the previous wheat crop would have perished.

The remedies which have been most successful are those in which methods have been adopted, to destroy the spores adhering to the seed-wheat previous to sowing. To accomplish this it is necessary to wash the grain thoroughly or to steep it in some weak poisonous solution, so as either to remove or to destroy the fungous germs without injuring the germinating qualities of the seed, and, moreover, it seems highly probable that a sufficiency of the material used for this purpose will adhere to the seed and protect it against the attack of any spores which may be present in the soil at the time the wheat is sown.

Of a great many remedies which have been tried with more or less success, I select the three following as being in my opinion, the best both for efficiency and convenience. The first and second I have myself frequently tried with manifest success. The third is given on the authority of Mr. Worthington G. Smith.

1. Sulphate of Copper, also called "Bluestone" or "Blue Vitriol."

This substance can usually be procured in any part of Canada from Druggists or General-store Keepers, at about 10 cents per lb. so that the cost of treating seed with the strongest solution recommended below, would not exceed 2½ cents per bushel. The different methods of applying this substance to the grain vary slightly; but the differences are merely with regard to the extent

to which it is deemed advisable to wet the seed. Some advise soaking the grain; but it would appear from the results of many experiments that this is not necessary. Mr. Worthington G. Smith advises the following: "1 lb. of bluestone dissolved in 5 "quarts of boiling water is sufficient for a sack of four imperial "bushels. The wheat is soaked for 10 minutes, or the 10 pints of "solution may be poured over till all is absorbed."

Mr. S. A. Bedford of Moosomin, N.W.T., who has had considerable experience as a farmer in Manitoba and the North-West Territories, tells me that the following method has proved successful in his district.

"One pound of Sulphate of Copper is dissolved in a pailful of hot "water, which is then sprinkled by one person over 10 bushels of "wheat placed in a waggon box, whilst some one else keeps the grain "well stirred. Should a large amount of smut be detected in grain "required for seed, the solution is made stronger, double the "quantity of bluestone being used."

The chief advantage claimed for this method is that in a few hours the grain is sufficiently dry to sow with the drill.

Mr. C. S. Plumb, of the New York Experimental Station, used 4 oz. of Sulphate of Copper in one gallon of water, and reports that "seeds soaked seventeen and a-half hours in this solution were found "to produce a slight amount of smut. Soaked forty hours all "germs of the fungus were killed."

It is to be noted that Mr. Plumb's experiments were with oats, in which, from the fact that the seed is contained inside a comparatively loose husk, there is much more difficulty in removing or destroying all the smut-spores than is the case with the smooth and naked grains of wheat.

2. Brine and Lime.

A remedy generally available at country farm houses and from which good results have been secured, is to soak the grain for 10 or 15 minutes in brine of the ordinary strength used for pickling pork (*i.e.* in which a fresh egg will float). If well stirred many of the smut spores, smutty and imperfect grains, &c., will rise to the surface, and can be skimmed off and destroyed. After the brine is

poured off, the wheat must be dried by dusting lime over it until all the grains are white.

It is claimed that sprinkling the brine on the grain instead of soaking it as above, before dusting it with lime has been found successful; but I have never tried this method.

3. Alkaline Water.

It might happen that none of the above-mentioned materials were obtainable and in such case the mere washing of the seed would be beneficial. Mr. Smith says "as the spores are lighter than water "steeping in brine or even pure water is often effectual, as the spores "float, and are easily washed away. Some alkaline ley should be "added if water is used, as the oil on the surface of the spores com-"bines with the alkali and forms a soapy substance which is fatal to "effectual spore germination."

An alkaline ley suitable for the above purpose may be made by adding to three or four gallons of boiling water, in any suitable vessel, one gallon of hard-wood ashes and stirring frequently until the alkaline properties of the ashes are extracted; or an alkaline solution of sufficient strength may be made by dissolving about 2 lbs. of ordinary washing soda in a pailful of water.

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CENTRAL EXPERIMENTAL FARM,

DEPARTMENT OF AGRICULTURE.

OTTAWA, - - - - CANADA.

BULLETIN No. 4.

MARCH, 1889.

To the Honourable the Minister of Agriculture:

Sir,

I have the honour to transmit herewith the fourth Bulletin from the Central Experimental Farm. This relates to the Ladoga wheat which was first imported under your instruction from Northern Russia in 1887, with the object of securing an early ripening variety of hard wheat, of such quality as would compare favourably with the best hard wheats now in cultivation in the Northwest of Canada. The results submitted in the accompanying Bulletin indicate a gratifying measure of success obtained in this undertaking.

The first part prepared by myself treats of the earliness, fertility and quality of the wheat; the second part, which has been prepared at my request by Mr. Frank T. Shutt, Chemist of the Dominion Experimental Farms, relates to the chemical constituents and physical characters of wheat, and gives the results of the chemical analyses conducted by him of a number of samples of Ladoga, Red Fife and other varieties of wheat.

I have the honour to be,
Your obedient servant,

WM. SAUNDERS,
Director.

Ottawa, March 22nd, 1889.

Central Experimental Farm.

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DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - CANADA.

LADOGA WHEAT.

Part I.—By Wm. Saunders, F.R.S.C., F.L.S., F.C.S., Director of the Dominion Experimental Farms.

Importance of obtaining Early Ripening Varieties.

The question of early ripening varieties of grain, and especially of wheat, is one of the utmost importance to the future of Canada The Provinces of Prince Edward Island and New Brunswick, the Northern portions of Quebec and Ontario, and the great plains of the North-West, all have a short season, and the immense advantages which would accrue to the farmers in all these sections of our country from the introduction and dissemination of early ripening sorts of wheat, barley and oats, and the annual saving this would effect would be difficult to over-estimate. But the wheat problem is the subject of the present Bulletin, and it is to the needs of the North-West settlers that we would at this time direct special attention. The soil of the great plains of Manitoba and the North-West Territories is stored with such an abundance of fertility that the capacity for production can scarcely be estimated provided that the difficulties associated with a short season can be partially or wholly overcome by the introduction of early ripening sorts To meet the requirements in this case, not only must the variety of wheat be early in ripening, but it must also possess such superior qualities as will command for it a relatively high price in the markets of the world; otherwise the cost of transporting so bulky a product over long distances would leave but little profit to the grower. It is a singular

fact that the northern countries of the world, where the difficulties surrounding agriculture are greatest, both in the way of production and access to markets, are the only countries producing wheat of the highest quality, and it is found to be a necessity by millers everywhere, who aim to produce first-class flour, to add to the softer wheats produced in temperate and southern latitudes a large proportion of the hard wheats grown in northern countries, and it is said that the larger the proportion of hard wheat used the stronger and better will be the flour. While India produces some hard wheat in limited quantities, most of the hard wheats which find their way to the markets of the world are the growth of the northern plains of Russia, the northern United States, and the North-West Provinces of Canada.

Fife Wheats.

The varieties of wheat known as Red and White Fife, grown in the Canadian North-West, deservedly rank among the best wheats in the world, and the high grades of flour produced from them command the best prices obtained for this product, and were the Fife wheats a little earlier in ripening, nothing better need be desired. In the northern parts of the United States the same or similar wheats are grown under the names of Fife, Saskatchewan Fife and Wellman's Fife. The following account of the origin of Red Fife Wheat is given in the Canadian Agriculturist for 1861: "About the year 1842 Mr. David Fife, of the Township of Otonabee, Canada West, now Ontario, procured through a friend in Glasgow, Scotland, a quantity of wheat which had been obtained from a cargo direct from Dantzic. As it came to hand just before spring seed time, and not knowing whether it was a fall or spring variety, Mr. Fife concluded to sow a part of it that spring and wait for the result. It proved to be a fall wheat as it never ripened, except three ears, which grew apparently from a single grain. These were preserved, and although sown the next year under very unfavorable circumstances, being quite late and in a shady place, it proved at harvest to be entirely free from rust when all wheat in the neighborhood was badly rusted. The produce of this was carefully preserved, and from it sprung the variety of wheat known over Canada and the Northern States by the different names of Fife, Scotch and Glasgow."

Russian Wheats.

In Russia a number of different sorts are grown, but in the northern provinces the Saxonka and Kubanka varieties form a large proportion of the shipments. The Saxonka wheat is known also under the name of Colonist wheat, and it is alleged that it is the identical wheat which was distributed by Peter the Great among the colonists whom he forcibly placed on the great plains of Russia. It is rather small in grain but hard in texture, and is held in esteem by millers in Great Britain as a mixing wheat, but does not command the high price which the best qualities of hard wheats from Canada and the United States readily bring. The Kubanka appears to be identical with what is known in Canada as Goose wheat, a variety of a hard ricy structure more or less transparent, which is regarded with much disfavor by millers in Canada who pronounce it to be one of the poorest varieties grown. In Russia it is hihgly esteemed and in the wheat markets of Europe it usually commands a price about equal to the Saxonka, which is usually about three-fourths the price of the best American hard wheats. It is a variety held in some favor by Canadian farmers in localities where the wheat midge prevails, as a midge proof wheat, for the reason that the kernel hardens so early that the midge is not able to injure it much. The outer covering of this wheat is thick, and the proportion of bran to flour is greater than in most other varieties, and notwithstanding that it is fairly rich in gluten its growth should not be encouraged where wheats of better quality can be matured.

The Ladoga.

In Bulletin No. 2 reference was made to the importation of an early ripening spring wheat from one of the northern Provinces of Russia. The object sought in its introduction was to obtain a hard wheat of good quality which would ripen early enough to escape the autumn frosts which sometimes injure the crops in some parts of the North-west of Canada. This wheat was selected by a seed dealer in Riga who had made a special study of the cereals of northern Russia, but the exact locality of its growth, and the name under which it is known had not been ascertained at the time Bulletin No. 2 was issued. It was grown in Latitude 60° near Lake Ladoga, north of St. Peters-

burg, and is known under the name of Ladoga. The locality referred to is by latitude 840 miles north of the City of Ottawa, 600 miles north of Winnipeg and north of the northern boundary of Lake Athabasca, in the Peace River country. The Ladoga wheat is said to be highly esteemed in those parts of Russia where it is grown, and is in favour as an early ripening sort. The first consignment was brought to Canada in the spring of 1887, when 667 sample bags were distributed for test, from which 275 returns were received, and from these reports the average period of ripening was estimated from ten to fifteen days earlier than Red Fife, a gain in time of maturing which would if maintained materially lessen the risk of injury from frost. In the spring of 1888 a second distribution of this wheat was made, when 1,529 sample bags, of 3 lbs. each, were sent out, from which 301 reports have been received. These place the period of ripening, taking in the entire Dominion, at 10 days earlier than the Red Fife.

Its Fertility.

The relative fertility of this wheat is also an important feature, and in this particular it will be seen from the following table that the Ladoga makes a very fair showing:—

Returns Received for 1887.	No. of Returns.	Yield from 3 lbs. Sown.			Time from Sowing to Harvesting
		Largest.	Smallest.	Average.	
		lbs.	lbs.	lbs	days.
Manitoba............	83	165	30	76½	102
N. W. Territories......	68	236	21	85	105
British Columbia.....	3	112	64	85	93
Ontario	67	60	10	27	90
Quebec....	15	40	6	19	85
Nova Scotia........	15	89	20	53	102
New Brunswick	24	60	8	30	97

Being an average yield of a little over 58 lbs. from each 3 lbs. sown.

The returns for 1888, as indicated by the reports received, may be thus summarized :—

Returns Received for 1888.	No. of Returns.	Yield from 3 lbs. Sown.			Time from Sowing to Harvesting.	No of Days earlier than Red Fife.
		Largest.	Smallest.	Average.		
		lbs.	lbs.	lbs.	days.	
Manitoba........	51	100	12	38	123	9¼
N. W. Territories......	69	178	12	63	122	10¼
British Columbia.....	8	183	53	126	113	8½
Ontario............ ...	113	97	8	44	99	9
Quebec	20	138	16	50	101	11½
Nova Scotia.	14	44	10	26	120	10
New Brunswick.......	11	92	34	59	107	12
Prince Edward Island	15	199	15	46	115	9½

This is equal to an average yield of a little more than 50 pounds from each 3 pounds of seed, and compared with Red Fife it is just ten days earlier.

The summer of 1887 was exceptionally hot and dry in Ontario and Quebec. and the crops of all cereals were light and their ripening premature. On the Central Experimental Farm a field of fourteen acres of Ladoga wheat sown on the 7th of May was harvested in 76 days from the date of sowing, the Ladoga ripening eight days earlier than the Red Fife sown at the same time in an adjoining field. On the 17th of May, 1888, this experiment of sowing was repeated and the field of Ladoga ripened in 81 days, the Red Fife in 92 days, a difference of eleven days. During the past season the grain in Manitoba and the North-West Territories has been unusually slow in ripening, so also in the Maritime Provinces owing to the remarkably low average temperature during the growing season; the conditions in Ontario and Quebec have on the whole been more favourable. These circumstances will aid in explaining the differences in the results for the two years. The falling off in yield in Manitoba and the North-West Territories during 1888, was mainly due to the very backward season and to the advent of unusually early frosts which in many cases nipped the grain before it was mature and materially lessened the crop.

Relative Quality.

The quality of the Ladoga wheat is a very important consideration. The very high character of the Red Fife wheat grown on the western plains of Canada and the excellent quality of the flour prepared from it, has created a demand for this wheat at the highest market prices, and it is of the utmost importance that this good reputation be maintained; the introduction of any wheat of a manifestly inferior quality which would tend to lower the standard of Canadian hard wheat would be highly impolitic. The original Ladoga wheat has been submitted to a number of experts, the majority of whom place it in the next grade below No. 1 hard, and estimate its value at from 4 to 5 cents per bushel less than the best quality of Red Fife, but some of the samples grown from this seed have improved so much as to entitle them to grade with grain of high quality.

With the view of ascertaining the opinions of those who are held to be the most competent judges eight samples were chosen, representing the average quality of those received together with a sample of the original importation, and a small sample of the Saxonka and Kubanka wheats, which had been received from a correspondent who had grown them in Manitoba. Subsequently three of the heaviest and best samples of Ladoga were selected, making 14 in all. A portion of each was sent to the Boards of Trade in Montreal, Toronto and Winnipeg, to Mr. W. W. Ogilvie of Montreal, and to Mr. Frank E. Gibb, Dominion Grain Inspector at Port Arthur, for inspection, and to the Chemist of the Experimental Farms, Mr. F. T. Shutt, for analysis. The several Boards of Trade manifested a deep interest in the subject, and referred the samples in each case to a select committee of experts. Mr. W. W. Ogilvie kindly gave his careful personal attention to the subject, and Mr. F. E. Gibb reported fully on the first lot of average samples sent him, but through illness was prevented from reporting on the last and best samples.

The list of samples and the reports thereon are herewith submitted, with the numbers under which they were sent.

		Weight per bushel.
7	Ladoga—Original importation	61 lbs.
1	" grown at Lethbridge, N.W.T.	$60\frac{3}{4}$
2	" " Edmonton, N.W.T.	$61\frac{1}{2}$

		Weight per bushel.
3	Ladoga—grown at Plum Creek, Souris, Man.............	$60\frac{1}{4}$
4	" " Brandon Hills, Man.....................	60
5	" " Tatamagouche, Nova Scotia.........	60
6	" " Guysboro', N. S.........................	$61\frac{1}{4}$
8	Kubanka—grown in Manitoba.	
9	Saxonka " "	
10	Ladoga—grown at Wolseley, N.W.T........................	63
11	" " Touchwood Hills, N.W.T..............	64
12	" " Binscarth, Man..........................	65
13	" " Mowbray, Man............................	$64\frac{3}{4}$
14	" " St. Mary's, New Brunswick...........	64

A letter was forwarded with each set of samples similar to the following, which was addressed—

To the Secretary of the
Board of Trade, Montreal.

DEAR SIR,—

"I desire to get the opinion of your Board of Trade regarding a wheat which was distributed last spring from the Experimental Farm in Ottawa for test in different parts of the Dominion. It is well known that farmers in the northern parts of Manitoba and the Territories have in the past suffered much loss from frozen wheat, and they are very anxious to obtain some variety which will ripen a few days earlier than the Red Fife, so as to admit of its being harvested before the early frosts occur. So strong is this feeling that farmers are willing to grow inferior varieties rather than suffer such losses as they have experienced in the past."

"In view of this condition of things, efforts are being made under instruction of the Minister of Agriculture, to endeavour to secure an earlier ripening wheat of *good quality* as nearly up to the standard of the Red Fife as possible. You will bear in mind that the object of this introduction is not by any means to displace the Red Fife; I think the growth of that variety should be encouraged in every practicable way, but the Minister desires that an earlier wheat of *good quality* should be secured to be grown where the Red Fife does not succeed, and thus discourage and prevent as far as is practicable the introduction of soft and inferior varieties of wheat, so that the present high standard of our North-West grain may be generally maintained and at the same time the necessities of the farmers met and the settlement of the country stimulated."

" After much correspondence and enquiry, it was decided to order a supply for the first experiment from Riga, Russia. This wheat arrived late last spring, and not having been advised of its correct name, it was distributed provisionally under the name of 'Northern Russian Wheat.' I have since learned that it is known in Northern Russia under the name of Ladoga."

" I send you a sample of the original importation under No. 7 and the samples from 1 to 6 and 10 and 11 inclusive, have all been grown from this seed. In considering these samples it should be borne in mind that the seed was not received by the growers until from two to three weeks after the usual time of seeding, hence the grain is not so plump and well developed as it would have been had it been sown earlier."

" No. 1	was grown at	Lethbridge, Alberta, N.W.T.		
" 2	"	Edmonton	"	"
" 3	"	Plum Creek, Souris, Manitoba.		
" 4	"	Brandon Hills		"
" 5	"	Tatamagouche, Nova Scotia.		
" 6	"	Guysboro	"	
" 10	"	Wolseley, Assiniboia, N.W.T.		
" 11	"	Indian Reserve, Touchwood Hills, N.W.T.		

" I desire to have the opinion of your Board of Trade as to how these wheats would grade in the markets of this country and how they would compare with Red Fife in the price they would command. I also enclose, under Nos. 8 and 9, a few grains (I am sorry I cannot just now send more) of Kubanka and Saxonka wheats, which are being sold in Manitoba for seed. Kindly let me know how these compare in value with Red Fife and Ladoga and the prices these varieties would now command if placed on the market in quantities. I desire this information for the reason that frequent enquiries reach me from Manitoba and the North-West from farmers who seek information on these points."

" The reports which have been received show that the Ladoga wheat has ripened during the past season from 10 to 15 days earlier than the Red Fife. Should this early ripening habit prove permanent—which there is every reason to expect—and the wheat of a desirable quality, its further encouragement in the districts referred to is most important."

"You will, I trust, in view of the importance of this subject to the whole country, pardon the liberty I have taken and obtain for me the information asked."

Yours very sincerely,

WM. SAUNDERS,

Director Experimental Farms.

OTTAWA, January 30th, 1888."

The three samples referred to under Nos. 12, 13 and 14 were forwarded on the 2nd of February to the several experts and Boards of Trade, with letters, explaining that these were the three heaviest specimens which had been obtained.

The following replies were received :—

OFFICE BOARD OF TRADE,

10 St. John Street and 39 St. Sacrament Street,

MONTREAL, February 9th, 1888.

The Board of Examiners for wheat and other grain having taken communication of the letters from the Director of the Central Experimental Farm, Ottawa, dated 30th January and 2nd February, and having compared and examined the samples of wheat forwarded by the Director, reports as follows :—

That the Board learns with pleasure of the action of the Government in endeavouring to secure, through the Director of the Experimental Farm, a hard wheat of good quality that shall ripen earlier than Red Fife, the Board believing that while Red Fife should most certainly be grown wherever there is no danger to be apprehended from early fall frosts, it is of the greatest importance that a choice hard wheat shall be found that will ripen earlier than Red Fife and so may be safely grown in districts where such frosts occur.

That the samples of Ladoga wheat would, with the exception of No. 3, all grade as hard wheats, and the Board consider that, presuming the stated advantage of time in maturing is fully established, its introduction will be very advantageous wherever early harvesting is desirable.

That a comparison of the Ladoga wheat samples with the Fife wheats, to be of any value can only be made by providing a miller with a sufficient quantity to be ground and afterwards baked. From a trade point of view, however, the Board considers that should any

difference in favour of Red Fife be established, the advantage would be trifling as compared with the importance of securing to the farmer a wheat that would ripen from two to three weeks earlier.

That the exception made by the Board regarding sample No. 3, is because that wheat would not grade above ordinary spring wheat; and it would appear either that some mistake must have been made respecting the original seed, or in the product sent to the Director, for it seems scarcely possible that the samples of Ladoga wheat submitted could have so deteriorated in one sowing as to produce so inferior a grain

That with regard to the samples of Kubanka and Saxonka wheats, the Board condemns both as being very inferior grain, and quite unsuitable for seeding purposes.

Signed on behalf of the Board of
Examiners for Wheat and other Grain.
HUGH McLENNAN,
Chairman.

TORONTO BOARD OF TRADE.

"Report of the Committee of Millers, Grain Dealers, Grain Exporters and Grain Inspectors, to whom was referred the communications and samples sent to the Secretary of the Board by Prof. Wm. Saunders, Director of the Central Experimental Farm."

"To the President and Council of the Board of Trade.

"Your Committee sat on the afternoon of the 4th February, 1888, examined the samples and discussed the subject, which, in their opinion, is one of very great importance."

"The conclusions to which they arrived are as follows:—

"The most important test of commercial merit in a spring wheat sample is the percentage and quality of gluten it contains."

"The examination made by the committee of sample 7, the original importation, and of samples 3 and 4 (those grown at Plum Creek and Brandon Hills), shows that all three are very deficient in gluten, or strength, being not superior to the present standard of No. 2 spring of Ontario growth."

"No. 2 spring is at present worth 80 cents per 60 lbs. here; No. 1 Manitoba hard, which contains 85 per cent. of Red Fife, is worth 90 cents. The answer to the enquiry as to how these wheats would compare in value with Red Fife would therefore be: Pure Red Fife is worth 11 to 12 cents per bushel more than samples 7, 3 and 4."

"The committee selected samples 7, 3 and 4 for comparison for the reason that they were grown in the same section of Manitoba from which comes the bulk of the Red Fife with which they are familiar."

"Sample 8, Kubanka, is the wheat grown to some extent in Ontario, under the different names of Arnecta, Rice or Goose Wheat. The demand for this wheat is limited, and when the quantity grown in Ontario was large compared with the quantity grown in Ontario now, the price was 20 to 23 cents below the price of No. 2 spring, say 35 cents below the price of No. 1 hard Manitoba. This wheat is also a later wheat to ripen than Fife wheat."

"Sample 9, Saxonka, is a poor, thin sample, containing a small mixture of Kubanka or Arnecta. If free from this it would inspect No. 3 spring, worth 77 cents as against 90 cents for No. 1 hard."

"The Ladoga would be a fair marketable wheat of the soft variety and preferable to badly frosted Red Fife."

"If it is a fact that any section of the wheat-growing North-West cannot be made to produce unfrosted Red Fife by proper farming, we would recommend that the Ladoga be tried in such localities, if by further experiments you fail to find a more glutinous wheat, possessing all the early ripening quality of the Ladoga"

"In the interests of the North-West, however, it is to be hoped that every experiment will be exhausted in the direction of retaining pure Red Fife sowing before settling down to soft wheats of any variety."

"An exceptionally bountiful crop of Red Fife, and an exceptionally poor crop of winter wheat, in the same year might result in the price of the latter approximating the price of the Fife, because the flours from the two varieties are not interchangeable for many purposes. But no surplus of Red Fife and scarcity of such wheats as samples submitted, could bring the value of the latter to, or nearly to, the value of Red Fife. The Red Fife flour will answer in every case where flours from your samples will answer, and with greater satisfaction and economy."

"Instances are known to some members of the committee of No. 1 hard and No. 2 frosted, being ripened side by side, from the same field in Manitoba, the soil and seed the same; the only difference being, in the first case the ground was ploughed and harrowed in the fall, thereby admitting of a few days earlier seeding, than in the second case where the ploughing was done in the spring."

"In view of the great importance of keeping up the growth of hard wheat, important to all interests, but most important of all to the North-West farmers, the committee report that in their opinion the greatest efforts should be made to extend its growth, and if other varieties than Red Fife must be used, such varieties as contain the largest percentage and best quality of gluten should be given preference."

"For determining the percentage and quality of gluten, the committee would recommend chemical analysis of all samples proposed to be experimented with, this being the one reliable test for a small sample"

"The samples last received (12, 13 and 14), are excellent in their plumpness and weight, but are quite as soft and deficient in strength as the former samples, and in value would bring about 2 cents per bushel more if offered for sale in quantity, than the samples first received."

(Signed,) H. McLAUGHLIN,
Chairman of Committee.

COMMITTEE.

H. McLaughlin,	R. J. Stark,	J. L. Spink,
John Reed,	H. N. Baird,	J. Carruthers,
Thomas Flynn,	S. A. Chapman,	R. C. Steele,
Joseph Harris,	W. Taylor,	W. D. Matthews, Jr.

WINNIPEG BOARD OF TRADE.

SECRETARY'S OFFICE,
CIVIC BUILDINGS,
Winnipeg, Man., 16th February, 1888.

The Council Winnipeg Board of Trade.

GENTLEMEN,

Your Board of Grain Examiners have to report that they have carefully examined the samples of Russian wheat forwarded to the Board by Prof. Saunders, Director of the Government Experimental Farm at Ottawa, and which he requests the Board will express an opinion on

After viewing the samples your Grain Examiners find as follows:

The original sample of Ladoga wheat, and some of its best matured products grown in Manitoba, would value with grades of the "Northern" classes.

We find that most of the samples submitted are not fully matured, and they are all lacking in good colour.

Sample No. 3 (grown at Souris, Man.), would seem not to belong to the Ladoga variety of wheat, being a wholly soft specimen which would grade as "No. 3 spring."

Nos. 1 and 11 (grown at Lethbridge, N.W T., and Touchwood Hills, N.W T, respectively), show the effects of frost action.

No. 2 (grown at Edmonton, N.W.T.), has a bleached look, which might arise from a very slight touch of frost or the effects of hot winds.

For seeding purposes we would recommend the original sample from Russia in preference to any of the others submitted

The best sample, No. 13 (from Mowbray, Man.), and the original from Russia would be worth five cents less than No. 1 Manitoba Hard (containing 85 per cent. of Red Fife), for milling purposes. Necessarily this opinion must be subject to a milling test, or chemical analysis

None of the eleven samples of the products of the Ladoga variety, bear any close resemblance to the original sample forwarded, and are, for the most part, unlike one another. This may be owing to the lateness in sowing or other unfavourable conditions, and we are of the opinion that a test, during another year or two, must be made before its value for this country could be positively ascertained.

Prof. Saunders has asked, also, for the Board's opinion as to the relative value borne by certain samples of Kubanka and Saxonka wheat (forwarded by him) to the Red Fife and Ladoga varieties.

In the opinion of this Board of Grain Examiners the millers and grain dealers of Manitoba would not purchase Kubanka wheat at any price, though it might, however, be useful for feed purposes. We understand that this variety of wheat is being sold in Manitoba this season for seed. In the opinion of your Examiners the sample submitted by Prof. Saunders is none other than "goose" or "rice" wheat and of little value.

The Saxonka variety belongs to the spring or soft class of wheats. The sample examined, however, is so poor that it would only grade as "rejected."

Your Grain Examiners are firmly of the opinion that the cultivation of Red Fife wheat should be persevered in, and that farmers will speedily discover the system of soil preparation by which they can

insure early seeding with the early and safe maturing of this invaluable variety.

All of which is respectfully submitted.

(Signed),

GEO. J. MOULSON,
Chairman.

CHAS. W. BELL,
Secretary, Board of Grain Examiners.

REPORT OF W. W. OGILVIE, ESQ.

MONTREAL, FEB. 3rd, 1888.

PROF. W. SAUNDERS,
Director Central Experimental Farm,
Ottawa.

Dear Sir,

Your favor of the 30th ulto., with 11 samples of wheat, came duly to hand. I have examined them carefully and beg to submit the following report:—

The sample of Kubanka wheat grown in Manitoba is what is known as Goose wheat. Its growth should be discouraged as much as possible, as its value is fully 15 cents per bushel less than Red Fife wheat.

The sample of Saxonka wheat grown in Manitoba is also a poor wheat that should not be encouraged for seed

Sample No. 7, Ladoga wheat, being the original importation from Riga, is not pure hard wheat, having a mixture of soft wheat in it.

Sample No. 10, grown at Wolseley, shows the best result of last year's growth, and would inspect Extra Hard.

Samples No. 1, No. 2, No. 6 and No. 11 would inspect No. 1 Hard, and sample No. 5, grown in Nova Scotia, would inspect No. 2 Hard.

Sample No. 3, grown at Plum Creek, would inspect No. 1 Spring, being the fourth grade of wheat. From the way this sample has degenerated in one year, would lead me to infer that the Ladoga wheat would not long maintain its hardness but will degenerate into ordinary Spring wheat.

I have had a good deal of experience in the growing of Russian wheat in Canada, my father having been among the first to import it. I have also visited the wheat fields of Russia and experimented upon its growth in this country. The Mennonites in Southern Manitoba also brought Russian wheat with them. My experience has proved that these wheats soon degenerate into ordinary Spring wheat in this

country, and at best never had the bright shining gloss that you find on Red Fife wheat. The Russian wheat also grinds harsh, and the flour is not equal to Red Fife.

Notwithstanding all that has been said and written about early ripening wheat, after many experiments, my experience has been that Red Fife wheat will ripen as early and yield as well as softer wheats, and is worth 10 cents per bushel more than soft wheat. Many of these tests have been in Manitoba. The complaints from Red Fife wheat in Manitoba have been caused by late sowing, the richness of the soil, weather and cool nights in August; but I am of opinion that with early sowing and favourable August weather, these complaints will disappear.

We must also bear in mind that Manitoba and the North-West Territories are among the few countries that can grow hard wheat, and therefore we should discourage the growth of soft wheat that can be grown in more than three-fourths of the wheat fields of the world, while hard wheat can only be grown in Hungary, Russia, Dakota and Minnesota, the farmers in Dakota sow entirely Red Fife wheat, and its flour has attained a world wide reputation. The soil of Manitoba is better than Dakota and Minnesota and will grow Red Fife wheat better than any country in the world, so I hope you will realize the necessity of encouraging the growth of Red Fife as much as possible and discouraging all other varieties of wheat.

I have had many tests made of the value of flour ground from Red Fife wheat grown in Manitoba, and they have always been satisfactory. I enclose you a few copies of the last test taken in London, Eng., with other prominent brands of flour.

Many farmers who have gone from Ontario to Manitoba, have taken seed wheats of soft varieties with them, which affect many samples of Manitoba wheat and causing so much of it to inspect Northern. The complaint that has been made against Red Fife not ripening as early as any other wheat, I think is altogether a mistake and can be attributed largely to the farmers or cold nights in August, that would have had the same affect on soft wheat.

Yours truly,

W. W. OGILVIE.

MONTREAL, FEB'Y. 7TH, 1888,

PROF. W. SAUNDERS,

Experimental Farm, Ottawa.

Dear Sir,

Your esteemed favor of the 2nd instant, to hand, with 3 samples of wheat: the 3 are splendid wheat, being brighter than those previously received, but still have not the gloss of Fife wheat, and would not make so saleable a flour. Sample No. 13 is the best, No. 12 nearly as good, both would inspect Extra No. 1 Hard. No. 14 shows too many soft grains for first sowing and gives indication that it would soon degenerate into soft wheat. Notwithstanding what Mr. Smellie reports, I am inclined to think that the weather between the 8th and 26th April, must not have been good sprouting weather, or the Fife wheat would have ripened as early as the Russian. I am very strong upon this point, after my past experience, and my anxiety to have Red Fife wheat sown for Manitoba, and no others, as I am satisfied it is the best wheat for the country.

Yours truly,

W. W. OGILVIE.

PORT ARTHUR, DEC. 24TH, 1887.

PROF. WM. SAUNDERS,

Central Experimental Farm, Ottawa,

Dear Sir,

Yours to hand with samples of wheat grown at different points in the Dominion, from seed purporting to have been imported from Russia. I do not express any opinion as to the milling qualities as compared with Red Fife as grown at present in Manitoba, as you say you are to have that from the best millers. Judging from the samples I have from you, I should think this Russian wheat is not likely to improve on any light soils, it will run into soft wheat. It is more adapted to heavy clay land, and I think when grown there will be found to produce a very hard berry, grading equal to the best Red Fife.

A comparison of No. 3 with No. 2 shews such extreme points that it is difficult to believe they were both grown from the same seed. I have seen the same thing occur when the points were only seven miles apart but different soils.

If the millers pronounce this Russian wheat equal in milling properties to the Red Fife, and the testimony as to its ripening from 10 to 15 days earlier, undoubted, there will be no question about its

being the wheat for Manitoba to grow. The Red Fife was so good in quality for the crop of 1886, and both in quality and yield for 1887, that I doubt very much the advisability of trying anything else until that fails entirely. The Russian, however, if not the Red Fife itself, bears a very strong resemblance to it.

The "Kubanka" and "Saxonka" had better be left in their original fields being simply "Goose" or "Rice" wheat. Herewith I append Inspection Grades on the different samples.

Yours truly,

FRANK E. GIBB.

INSPECTION OF NINE SAMPLES OF WHEAT RECEIVED FROM WM. SAUNDERS, CENTRAL EXPERIMENTAL FARM, OTTAWA.

7. Ladoga, from Riga, Russia, would grade No. 1 Northern. Resembles much of this year's crop in Manitoba.

1. Ladoga, grown at Lethbridge, N.W.T., grade No. 1, frosted, all hard, outside bran blistered, bright kernel, fair milling sample.

2. Ladoga, grown at Edmonton, N.W.T., grade No. 2, Manitoba hard wheat, all hard, bleached.

3. Ladoga, grown at Souris, Man., grade No. 1, spring, over 50 per cent. soft.

4. Ladoga, grown at Brandon Hills, Manitoba, grade No. 2, Manitoba hard wheat, nearly all hard, bleached.

5. Ladoga, grown at Tatamagouche, N.S., grade No. 3 Northern, much bleached.

6. Ladoga, grown at Guysboro', N.S., grade No. 2, Canada hard wheat, bleached.

8. Kubanka, grown in Manitoba, grade No. 1, Goose.

9. Saxonka, grown in Manitoba, no grade, much bleached, thin, and principally "Goose" wheat.

FRANK E. GIBB,
Grain Inspector.

PORT ARTHUR, Dec. 24, 1887.

A sample of Ladoga, grown at Moosomin, N.W.T., was also sent to Mr. Gibb with the others, which, through an oversight, was not included in the subsequent distribution. This was graded by Mr. Gibb as "No. 1 Manitoba hard wheat, good."

Another sample of Ladoga wheat, which was grown on one of the Indian Reserves from seed sent from the Experimental Farm at Ottawa, of the first importation, was sent by Mr. Wm. McGirr, of the Indian Department, Regina, to Mr. S. A. McGaw, of Ogilvie's Royal Mill, Winnipeg, which was submitted for examination by Mr. McGaw to the analyst employed by Messrs. Ogilvie in testing wheats. In a letter from Mr. S. A. McGaw to Mr. Wm. McGirr, dated December 4, 1887 (which I am permitted to publish) he says: "Our analyst in Montreal reports very favorably of the Russian wheat, and states that it contains a large amount of gluten, and being in most respects nearly if not equal to Red Fife."

The suggestions of the Toronto Board of Trade regarding the importance of determining the proportion of gluten by chemical analyses has been acted on, and a full account of a careful series of analyses will be found in the appended report of the Chemist of the Experimental Farms, Mr. F. T. Shutt. Those of the Boards of Trade of Montreal and Winnipeg have also been carried out, by providing a miller with a sufficient quantity of the wheat to be ground into flour, and having this flour made into bread.

All the samples which have been referred to as submitted for inspection were carefully put up by myself, taken from the same bags, and were all exactly alike, but the several reports of the experts to whom they were sent are of a very contradictory character. The Montreal Board of Trade grade all the samples of Ladoga, excepting one, as hard wheats. The Toronto Board of Trade grade every one of them as soft wheats. The Winnipeg Board of Trade give a definite opinion on three only. One of them, No. 3 (the same lot as was graded soft by the Montreal Board) is pronounced soft; Nos. 7 and 12 are graded hard wheats, worth 5 cents less than No. 1 hard. Mr. W. W. Ogilvie gives an opinion on ten out of the twelve samples submitted to him. Of the original Ladoga as imported, (No. 7) he says this "is not a pure hard wheat, having a mixture of soft grains in it." This opinion would probably entitle No. 7 to a place among the lower grades of hard wheat, but of the other nine samples No. 3 is the only one pronounced soft, and it is graded No. 2 Spring. Two of the others are said to be extra No. 1 hard, one extra hard, four No. 1 hard and one No. 2 hard. Mr. F. E. Gibb pronounces the original sample of Ladoga as resembling much of the Manitoba crop of 1887, and grades it as No. 1 Northern; of the other seven samples grown from this grain, which Mr. Gibb reported on, five were returned as hard wheats and two as soft.

As one of the more striking examples of difference of opinion, the sample grown at Mowbray, Man., may be cited. This the Montreal Board of Trade pronounced to be hard; the Toronto Board of Trade, soft; the Winnipeg Board of Trade as a hard wheat, worth 5 cents a bushel less than No. 1 hard; and Mr. W. W. Ogilvie as extra No. 1 hard. It cannot be said that Mr. Ogilvie is in any sense unduly in favor of Ladoga wheat, for while he practically pronounces eight out of the nine samples on which he gives an opinion as marked improvements on the original, he argues from the one soft sample that this wheat is degenerating, and likely to degenerate to a soft wheat, apparently forgetting that the contrary argument could be sustained with an eightfold force.

A better idea will perhaps be given of the differences of opinion throughout by placing the results in a tabulated form.

No.	—	Weight per Bushel.	Opinion of Montreal Board of Trade.	Opinion of Toronto Board of Trade	Opinion of Winnipeg Board of Trade.	Opinion of W. W. Ogilvie Montreal.	Opinion of F. E. Gibb, Port Arthur.
		Lbs					
7	Ladoga, original importation....................	61	Hard wheat......	Soft wheat, No. 2 Spring.	Hard wheat, Northern, 5c. less than No. 1 hard.	Not a pure hard wheat.	Hard wheat, No. 1 Northern.
1	" grown at Lethbridge, N.W.T	$60\frac{3}{4}$	Hard wheat	Soft wheat......	....	No. 1 hard......	Hard wheat, No.1 frosted
2	" " Edmonton, N.W.T..........	$61\frac{1}{2}$	Hard wheat......	Soft wheat......	....	No. 1 hard......	No. 2 Manitoba hard.
3	" " Souris, Man....................	$60\frac{1}{4}$	Soft wheat.......	Soft wheat, No. 2 Spring.	Soft wheat, No. 3 Spring.	Soft wheat No. 1 Spring.	Soft wheat, No. 1 Spring.
4	" " Brandon Hills..................	60	Hard wheat. ...	Soft wheat, No. 2 Spring.	....	....	No. 2 Manitoba hard.
5	" " Tatamagouche, N.S.........	60	Hard wheat......	Soft wheat......	....	No. 2 hard. ...	Hard wheat, No. 3 Northern.
6	" " Guysboro', N.S................	$61\frac{1}{4}$	Hard wheat......	Soft wheat......	....	No. 1 hard. ...	No. 2 Canada Hard.
10	" " Wolseley, N.W.T............	63	Hard wheat......	Soft wheat	....	Extra hard. ...	....
11	" " Touchwood Hills, N.W.T.	64	Hard wheat......	Soft wheat......	....	No. 1 hard. ...	....
12	" " Binscarth, Man	65	Hard wheat......	Soft wheat......	....	Ex. No. 1 hard	....
13	" " Mowbray, Man................	$64\frac{1}{4}$	Hard wheat.. ...	Soft wheat......	Hard wheat, 5c. less than No. 1 hard.	Ex. No. 1 hard	....
14	" " St. Marys, N.B..............	64	Hard wheat......	Soft wheat	....	Shows too many soft grains.	No. 2 Canada hard.
8	Kubanka, grown in Manitoba....................	....	Very inferior grain.	Goose wheat...	Of little value...	15c. per bushel less than Red Fife.	No. 1 Goose...
9	Saxonka " "	....	Very inferior grain.	A poor, thin sample No. 3 Spring.	Soft & rejected.	Poor wheat....	No grade. ......

The only sample that all the authorities agree on as being a soft wheat is No. 4, and this is so unlike the other samples that there is good reason for believing that some accidental foreign mixture has occurred either in the seed sent out or the sample returned.

CHEMICAL ANALYSES.

We shall next consider the chemical analyses which, in the opinion of the Toronto Board of Trade, is the one reliable test for determining the percentage of gluten. In order to have good samples of Red Fife to compare with the Ladoga, the Boards of Trade were asked to send authenticated samples of No. 1 hard, of the best character, and a similar request was made to Mr. W. W. Ogilvie. These solicitations were kindly responded to, and among the six samples of Red Fife referred to in Mr. Shutt's report one was sent from the Toronto Board of Trade, one from the Winnipeg Board of Trade, and one from the mills of Ogilvie & Co., Winnipeg, all of them graded as No. 1 hard. Of the other three, one was from Indian Head, N. W. T., a sample from a bag of Red Fife which had been awarded a first prize at several of the North-West agricultural exhibitions; one was obtained from Whyte's mills, Galetta, Ont., which had been purchased as Manitoba No. 1 hard in 1886; the sixth being a sample of Red Fife grown near Galetta from the last named imported Manitoba wheat.

It is singular that the sample of No. 1 Red Fife from the Toronto Board of Trade shows a fraction less of gluten than any of the other five samples, one of which was grown in Ontario, and that both the specimens from the Winnipeg Board of Trade and the first-prize specimen from Indian Head should yield a fraction less of gluten than the Ontario sample grown at Galetta from Manitoba seed.

In Mr. Shutt's report, appended, the average proportion of albuminoids (a term held as synonymous with gluten) in 11 samples of Ladoga is 14·31, while that from the six samples of Red Fife is 14·00. But if the comparison is restricted to the samples of Ladoga and Red Fife grown in Manitoba and the North-West Territories the proportion would be as follows: Ladoga, 14·57; Red Fife, 13·98—an appreciable difference in favor of the Ladoga variety. No chemical tests have yet been devised for determining the quality of gluten in flour. That which possesses the greatest elasticity is most esteemed in bread-making, and flour in which this quality of gluten predominates is designated "strong;" while that containing gluten, which is more of a ductile or pliable character without much

elasticity is not esteemed by bakers, but is sought for by the manufacturers of Maccaroni, and some forms of pastry. It would appear that the gluten in wheats having a ricy structure, such as the Kubanka or Goose wheat, the Polonian wheat and others of the same nature, while existing in fair proportion in their composition, lacks that elasticity in its character which is necessary to make "strong" flour. This difference in the quality of the gluten may be recognised by chewing a few grains of these different sorts of wheat, and noting the relative character and volume of the plastic mass which remains in the mouth. The reports of the bakers who have tested the flour of the Ladoga wheat, shows that the gluten it contains is not lacking in this desirable elastic or "strong" quality. Full particulars of the analyses of the Ladoga, Red Fife, and other varieties of wheat will be found in Mr. Shutt's report.

TESTS OF THE FLOUR.

On the 16th of November, 1888, sixteen bushels of Ladoga wheat, which had been grown on the Experimental Farm at Indian Head, was taken to the Qu'Appelle Valley Roller Mill, at Fort Qu'Appelle, with a similar quantity of Red Fife, of the best quality, which had been grown in an adjoining field. The proportion of bran, shorts and middlings to the flour obtained could not be accurately ascertained, as there was much waste in grinding so small a quantity. The flour of the Ladoga, when compared with the Red Fife, had a slight yellow shade. Bread from both these flours was carefully made under my own supervision, all the ingredients weighed, and it was found that the Ladoga flour absorbed more water and produced a little over 2 pounds of bread more from each 100 pounds of flour than could be made from the same quantity of Red Fife. This had been anticipated by Mr. Shutt from the smaller proportion of water found in the grain. The bread from both samples had a yellowish tint but a more decided yellow shade in that made from the Ladoga.

A sack of each sort of flour was sent to two of the leading bakers in Ottawa to be made into bread, and samples from each lot examined, compared and tested, and it was found that the only disadvantage that the Ladoga flour had was in point of color. With larger quantities available for milling, better results will no doubt be obtained, and by skilful admixture of some of the whiter soft wheats with this strong glutinous variety there is every reason to

believe that this yellowish tint can be successfully overcome and a highly satisfactory flour produced.

The following letters were received from the bakers to whom the flour was sent :—

OTTAWA, Dec. 27th, 1888.

Prof. WM. SAUNDERS,
Central Experimental Farm.

Dear Sir,

Having made bread from the two samples of flour sent me, I beg to say that the Red Fife is the weaker flour of the two, but it is a little better in color than the Ladoga brand.

The Ladoga would, in my opinion, make a good flour if properly dressed, with a per cent. of low grade taken out. It is a strong flour, and would make more bread to the barrel than Red Fife.

Yours respectfully,
S. S. SLINN,
Palace Bakery, Ottawa.

OTTAWA, Feb. 18th, 1889.

Prof. WM. SAUNDERS,
Central Experimental Farm.

Dear Sir,

We have baked at your request two samples of flour, one made of Red Fife wheat and the other called Ladoga. We are of opinion that the Red Fife would command the highest price, as it has the better colour, although neither of the samples are up to the mark in that respect. As to strength, Ladoga has more than the other, but the flour being darker we consider the Red Fife the flour suited for our trade.

Yours truly,
R. E. & J. C. JAMIESON.

It would be unreasonable to expect that any variety of grain would succeed equally well on all the different soils and in all the varied climates of the Dominion, yet it is interesting to compare the reports of tests of the same wheat grown under so many different conditions. Both rust and smut have been much more common in 1888 than they were in 1887, and the Ladoga seems to have suffered more than some other varieties; yet the total number of unfavorable reports among the 301 returns is but 45, of which 26 were from Ontario, 1 from Quebec, 1 from Nova Scotia, 9 from

Manitoba and 8 from the North-West Territories. The best results obtained with the Ladoga wheat have been on soils of medium character, not too rich and heavy, but on mixed sandy and clay loams, associated with more or less gravel. The Ladoga is very vigorous in its growth, and when sown on very rich soil it has rusted in some instances very badly. This, however, has been the case with Red Fife also during 1888; indeed, rust has been very general and very injurious. The Ladoga seems to be much more affected with loose smut than the Red Fife is, but in many localities the Red Fife is seriously afflicted with the "bunt" smut, which is much the more objectionable of the two, and from this the Ladoga appears thus far to be free. In bulletin No. 3, Mr. James Fletcher, Entomologist and Botanist to the Experimental Farms, gives a very instructive account of the life history of these parasitic growths which every farmer should read. It is believed that both can be subdued, if not entirely got rid of, by soaking the seed for ten or fifteen minutes in strong brine shortly before sowing, draining off, and drying the seed with lime, plaster or ashes. Solution of blue vitriol (sulphate of copper) has also been found useful for this purpose, while immersing the grain in hot water at a temperature of 135° is said to have been entirely successful.

Mr. C. Montgomery, of Hilton, Ontario, uses salt very successfully for preventing smut, but in a different way. In a letter dated December 12, 1888, he says: "I give you with pleasure my method of treatment for smut. I place my wheat on the barn floor and mix one bushel of salt to five bushels of wheat, mixing thoroughly with a scoop. Then moisten with sufficient water to dissolve the salt, after which add fresh air-slacked lime until no more will adhere to the wheat; put up into a snug pile and let it stand for a couple of hours, after which I put it in bags and allow it to stand one day before sowing. Grain so prepared can only be sown by hand." Mr. Montgomery says that he has used this remedy for many years past.

INDIVIDUAL RESULTS AND OPINIONS.

The following individual opinions are given as examples of the most successful results with the Ladoga wheat in the North-West Territories and Manitoba. Many more of the same character have been received, not only from the North-West but also from other Provinces in the Dominion:

Mr. Wm. Gibson, of Wolseley, N. W. T., a practical Scotch farmer, has the greatest record of success with the Ladoga of any person in the Dominion. From the 3 pounds sent him in the spring of 1887 he harvested 236 pounds, and from the second sowing has a few pounds over 150 bushels of clean seed. Another 3-pound bag was sent him in the spring of 1888 of the second importation from Russia. He says: "I sowed the same quantity of Red Fife, on the same day, 16th April, alongside of the Ladoga. The Ladoga was harvested on the 31st of August, the Red Fife on the 13th of September."

Mr. Wm. Summerton, of Moosomin, N.W.T., who received 3 pounds in 1887 has over 30 bushels this year. He sowed the Ladoga on the same day as the Red Fife, and alongside of it. The Red Fife was frozen, and brought 65 cents only on the Moosomin market, while the Ladoga was graded by the buyers as No. 1 hard, and $1.05 was offered for it for milling purposes. Mr. John Day, of Fleming, N. W. T., received the same quantity in 1887, and has also over 30 bushels this year, of excellent quality.

Mr. G. L. Smellie, of Binscarth, Manitoba, received a 3-pound sample in 1887. In his report he says the Russian (Ladoga) wheat was sown on the 26th of April, while our Red Fife was sown on the 8th of April. The former was cut dead ripe on the 17th of August, the latter from the 23rd August to 3rd September. The sample sent by Mr. Smellie was one of those submitted to the experts for inspection under No. 12.

R. B. Chappell, of Moosomin, who raised 170 pounds from the 3 pounds sent, says: "I sowed the Ladoga on the 28th of April and sowed Red Fife alongside of it on the same day. The Ladoga was cut on the 18th of August, the Red Fife on the 26th of August." T. D. Stewart, of Carman, Manitoba, harvested 90 pounds from the 3 pounds sown in the spring of 1887. He sowed the Ladoga three and a-half weeks later than his earliest sowing of Red Fife, and the Ladoga was cut a week earlier, and was so ripe at that time that nearly one-third of the crop was lost by shelling.

David Craig, of Edmonton, N. W. T., threshed 105 pounds from 3 pounds of seed, found it to be from seven to ten days earlier than Red Rife. Duncan McCuaig, of Portage la Prairie, harvested 100 pounds from the same quantity of seed, and says it is ten days earlier than Red Fife. Hugh Munro, of Calgary, N.W.T., harvested 160 pounds from 3 pounds of seed, and says it was ten days

earlier than Red Fife sown in the same field. Geo. D. Long, of Edmonton, harvested 100 pounds from a like quantity, and says that with him it is more productive than Red Fife, and ten days earlier. Thos. Miller, of Kirkpatrick, N.W.T., had a yield of 141 pounds, and says: "I am favorably impressed with the wheat; it is eight days earlier than Red Fife." Chas. Bowering, of Fleming, N.W.T., had a yield of 93 pounds, and says it is ten days earlier. Rev. L. Gaetz, of Red Deer, N.W.T., had 93 pounds from the 3 pounds sent him, and says it is ten to fourteen days earlier than Red Fife, and is more prolific.

SUMMARY.

The Ladoga wheat has been subjected to a searching criticism, tables of the entire results of its growth have been given, the public have been advised of such defects as have been noted during the progress of the two years' tests, and making the most liberal allowance for these defects, it seems not too much to say that the evidence thus far obtained is sufficient to show: That the Ladoga is a productive and valuable variety of hard wheat, which has thus far ripened over the whole Dominion ten days earlier on the average than the Red Fife. That the better samples obtained are fully as rich in gluten as the best Red Fife, and while the cultivation of the Red Fife should be recommended in every section of the North-West, where it is likely, with early sowing, to escape the autumn frosts, the growth of the Ladoga may be safely encouraged wherever the ripening of the Red Fife is uncertain, without incurring the risk of materially lowering the reputation or the general quality of Canadian hard wheats.

PART II.

REPORT

ON THE

CHEMICAL COMPOSITION AND PHYSICAL CHARACTERS

OF

LADOGA, RED FIFE AND OTHER VARIETIES OF WHEAT

BY

FRANK T. SHUTT, M.A., F.C.S., F.I.C.,

Chemist, Dominion Experimental Farms.

OBJECTS OF THE INVESTIGATION.

This series of analyses was undertaken with a view (1) to ascertain the composition, and hence the relative value, from a chemical standpoint, of the different varieties of wheat hereinafter enumerated, and more particularly those of Red Fife and Ladoga; (2) to determine what improvement or deterioration, if any, had taken place in the Ladoga grain by its culture in the various Provinces of Canada; (3) to find out what such alterations in composition, if any, were due to, *i. e.*, what influence, soil, climate and cultivation had exerted upon the grain.

To answer *all* these questions fully and satisfactorily will necessitate, first, the analysis of a larger number of samples and an investigation extending over several years, with a full and accurate knowledge of all the conditions of growth. It is therefore proposed to continue this inquiry in the future as time permits; and as the Experimental Farms are now established throughout the Dominion we shall be enabled to do so with all the reliable information regarding the nature of soil, the extent of cultivation and the climatic changes necessary to the solution of such difficult problems. In most cases where farmers have grown the Ladoga wheat

and sent back, samples only incomplete data as to soil, etc., have been furnished, and thus I am not in a position to draw conclusions, which I might otherwise have been able todraw.

While, therefore, at the present juncture and with such limited knowledge, it is impossible to offer a satisfactory solution to the third question, it will be my object in the present bulletin to indicate such conclusions as can be safely drawn from the analytical data for the elucidation of the first and second objects of this investigation.

From the results of the analyses satisfactory answers can, I believe, be given as to the relative values of the wheats, and also as to the effect on the composition of the Ladoga grain when grown in Canada.

VARIETIES ANALYSED.

Twenty-eight different samples of wheat have been analysed, including twelve of Ladoga, six of Red Fife, three of Saxonka, two of Kubanka, one of Onega, one of Red Fern, one of Clawson, one of Wellman's Fife and one of Blue Stem.

The specimens of Ladoga wheat are from the following localities: One from Riga, Russia, imported by the Central Experimental Farm in 1887, from which seed all the other specimens of this grain have been grown; four from the North-West Territories; four from Manitoba; two from Nova Scotia, and one from New Brunswick.

Of the Red Fife, one sample was grown in the North-West Territories; four, presumably, in Manitoba (two of these being graded as No. 1 Hard by the Boards of Trade at Toronto and Winnipeg, respectively, and a third as "No. 1 Hard" by the Ogilvie Milling Company, Winnipeg,) and one was grown in Ontario.

The Saxonka specimens include one imported direct from Russia, and one grown from this seed in the North-West Territories. The third was furnished by J. G. V. Field Johnson, Esq., of Manitoba.

The two samples of Kubanka comprise one grown by J. G. V. Field Johnson, Esq., in Manitoba, and one grown at the Central Experimental Farm, Ottawa.

The Onega grain was imported from Russia in the spring of 1888.

The Red Fern variety was furnished by the Citizens' Milling Company, of Toronto, and was raised within five miles of that city.

The Clawson, the only winter wheat of the series, was obtained from Galletta, Ontario.

The Wellman's Fife and Blue Stem were kindly sent by Prof. Porter, of St. Anthony's Park, Minn., and were grown in that State. Prof. Porter reports these as the two best varieties in that district.

DETAILED ANALYSES OF THE WHEATS.

The following table shows in detail, and in percentage quantities, the component parts of the grains analysed. The results in all the columns, save those headed Carbo-hydrates and Albuminoids, have been found by direct determination. The amount of albuminoids is obtained by multiplying the quantity of nitrogen by the factor 6·25, and that of carbo-hydrates (principally starch) by subtracting the sum of the other constituents from 100. Besides indicating the chemical composition, I have thought it well to insert in tabular form certain other data of a physical character which must be taken into consideration, together with the chemical results, when endeavoring to find the solution of the problems for which this investigation was undertaken. These data consist of the weight of 100 grains in grams, the color, hardness or consistency, weight per bushel, together with some additional explanatory remarks upon the nature of soil, etc.

The numbers under which the wheats are designated in the table are not the same as those which were used with them when they were sent to the experts for inspection.

My No. 1	is identical with	No. 7
2	"	1
3	"	2
4	"	10
5	"	11
6	"	3
7	"	4
8	"	12
9	"	13
10	"	5
11	"	6
12	"	14
21	"	9
23	"	8

TABLE

DETAILED ANALYSES

Number.	Name of Variety.	Locality where grown.	Spring or Winter.	Color.	Consistency.	Year of Growth.
1	Ladoga	Riga, Russia	Spring	Red	Hard	1886
2	"	Lethbridge, N.W.T.	"	"	"	1887
3	"	Edmonton "	"	"	"	1887
4	"	Wolseley "	"	"	"	1887
5	"	Touchwood Hills, N.W.T.	"	"	"	1887
6	"	Souris, Man.	"	"	P. Soft.	1887
7	"	Brandon Hill, Man.	"	"	Hard	1887
8	"	Binscarth, Man.	"	"	"	1887
9	"	Mowbray, Man.	"	"	"	1887
10	"	Tatamagouche, N.S.	"	"	"	1887
11	"	Guysboro', N.S.	"	"	"	1887
12	"	St. Mary's, N.B.	"	"	"	1887
13	Red Fife	Manitoba	"	"	"	1886(?)
14	"	Ontario	"	"	"	1887
15	"	Manitoba	"	"	"	1887
16	"	Indian Head, N.W.T.	"	"	"	1887
17	"	Manitoba (?)	"	"	"	1887
18	"	"	"	"	"	1887
19	Saxonka	Russia	"	L. Red	"	1886
20	"	Broadview, N.W.T.	"	"	"	1887
21	"	Manitoba	"	"	"	1887
22	Kubanka	Ottawa, Ont.	"	"	V. Hard	1887
23	"	Manitoba	"	"	"	1887
24	Onega	Russia	"	Red		1887
25	Red Fern	Toronto, Ont.	"	D. Red	M. Hard	1887
26	Clawson	Ontario	Winter	Y. White	Soft	1887
27	Wellman's Fife	Minnesota	Spring	Red	Hard	1887
28	Blue Stem	"	"	"	M. Hard	1887

I.

OF THE WHEATS.

Weight of 100 Grains in Grams	Weight per Bushel in lbs.	Water.	Ash.	Fat.	Fibre.	Carbo-hydrates.	Albuminoids, N ×6·25.	Nitrogen.	Remarks.
3·378	60¾	8·76	2·00	1·90	2·54	72·05	12·75	2·04	Original importation, C.E.F., 1887.
3·897	60¾	8·12	2·00	2·20	2·56	69·94	15·18	2·43	Dark loam; ripened 122 d'ys
3·217	61½	8·20	1·70	1·88	2·39	73·96	11·87	1·90	Sandy loam, laid by storm in August; frozen after cutting; 121 days.
3·855	63	7·00	1·65	2·00	2·12	71·30	15·93	2·55	
3·450	64	7·93	1·40	2·07	1·71	69·52	17·37	2·78	Light and heavy loam; 104 days.
3·199	60¼	9·00	1·70	1·91	2·80	72·47	12·12	1·94	Dry, sandy loam; 105 days.
3·240	60	8·38	1·70	1·89	2·38	73·40	12·25	1·96	99 days.
3·450	65	7·88	1·53	2·07	1·60	70·11	16·81	2·69	113 days.
3·470	64¾	7·50	2·06	1·98	1·71	71·75	15·00	2·40	87 days.
3·167	65	8·74	1·84	1·96	2 63	70·08	14·75	2·36	Gravelly loam.
3·412	61¼	7·84	2·00	1·83	2·55	72·03	13·75	2·20	112 days; wet clay.
3·265	64	7·78	2·13	2·10	2·30	73·01	12·68	2·03	99 days; sandy and argillaceous soil.
2·900	......	8·84	1·53	2·15	2 35	70·38	14·75	2·36	Obtained from White's Mills, Galletta, Ont.
2·355	......	10·06	1·99	1·93	2·64	69·51	13·87	2·22	Seed grown from No 13 in Ontario.
3·105	......	9·22	1·58	1·90	2·12	70·87	14·31	2·29	Graded No. 1 hard by Ogilvie & Co., Winnipeg
3·194	......	9·50	1·37	2 03	1·75	71·67	13·68	2·19	Grown near Indian Head.
3·075	63¼	8·76	1·61	2·12	2·02	71·99	13·50	2·16	Graded No. 1 hard by Toronto Board of Trade.
2·956	......	9·27	1·64	2·06	1·68	71·67	13·68	2·19	Graded No. 1 hard by Winnipeg Board of Trade.
2·515	......	9·99	1·95	1·87	1·60	71·28	13·31	2·13	Original importation, C.E.F., 1887.
2·750	......	8·60	1·56	1·89	2·20	71·19	14·56	2·33	Grown at Crooked Lake Reserve from No. 19.
2·097	......	8·00	1·72	2·01	2·87	71·53	13.87	2·22	Obtained from Field Johnson, Esq.
2·755	......	8·73	1·90	1·98	2·16	71·80	13·43	2·15	From seed grown in Russia
3·612	......	8·35	1·60	2·08	2·62	71·29	14·06	2·26	Obtained from Field Johnson, Esq.
1·750	......	9·23	2·00	2·32	1·54	71·48	13·43	2·15	Original importation, C.E.F., 1888.
2·275	......	9·36	2·07	2·20	1·94	70·18	14·25	2 28	Obtained from Citizens' Milling Co., Toronto.
3·534	......	9·45	1·84	1·69	2·96	72·44	11·62	1·86	Obtained from White's Mills, Galletta, Ont.
3·481	......	10·19	1·73	2·09	2·41	69·90	13·68	2·19	Obtained from Prof. Porter, St. Anthony's Park, Minn.
2·954	......	8·73	1·90	2·13	2·62	72·87	11·75	1·88	Obtained from Prof Porter, St. Anthony's Park, Minn.

ALBUMINOIDS (GLUTEN).

The most important constituent of wheat is gluten, the amount of which in the different grains is found in the column headed Albuminoids. I therefore propose to discuss, first, the relative qualities of the wheats from the quantity of this constituent they possess.

For practical purposes, the terms gluten and albuminoids may be considered synonymous. Scientifically speaking, however, gluten is regarded as a mixture of several albuminoids which behave differently to various solvents. Chemical analysis, however, has demonstrated that, though differing in physical properties these albuminoids are almost if not entirely identical in composition, and therefore may be viewed as one, under the generic term albuminoids. As already stated, the quantity of such is ascertained by the multiplication of the amount of the contained nitrogen (directly determined) by 6.25.

Government inspectors and milling experts grade wheats principally by the consistency or relative hardness of the grain, a character which depends almost directly upon the percentage of gluten—it being true, as a rule, that the greater the percentage of gluten the harder the wheat.

To compare these wheats among themselves from this standpoint I have prepared the following table of averages. It shows the average percentage quantity of gluten in the different wheats, and also the percentage of this constituent in the same wheat when grown in the various Provinces, which latter is intended to bring out the effect of locality in increasing or diminishing the amount of gluten. Another column gives the weight of 100 average grains in grams, and the relation which this has to the quantity of gluten, will be discussed in a succeeding paragraph.

TABLE II.

AVERAGE COMPOSITION OF THE WHEATS WITH RESPECT TO GLUTEN —ALSO SHEWING RELATION BETWEEN GLUTEN AND WEIGHT OF 100 GRAINS.

Name of Wheat.	Locality where Grown.	No. of Analyses.	Nitrogen.	Albuminoids, N × 6·25.	Weight of 100 Grains in Grams.
Ladoga	Russia	1	2·04	12·75	3·378
"	North-West Territories	4	2·415	15·08	3·605
"	Manitoba	4	2·25	14·06	3·335
"	Nova Scotia	2	2·28	14·25	3.289
"	New Brunswick	1	2·03	12·68	3·265
Red Fife	North-West Territories	1	2·19	13·68	3·194
"	Manitoba	4	2·25	14·06	3·031
"	Ontario	1	2·22	13·87	2·355
Saxonka	Russia	1	2·13	13·31	2·515
"	North-West Territories	1	2·33	14·56	2·750
"	Manitoba	1	2·22	13·87	2.097
Kubanka	"	1	2·26	14·12	3·612
"	Ontario	1	2·15	13·43	2 755
Onega	Russia	1	2·15	13·43	1·750
Red Fern	Ontario	1	2·28	14·25	2·275
Clawson	"	1	1·86	11·62	3·534
Wellman's Fife	Minnesota	1	2·19	13·68	3·481
Blue Stem	"	1	1·88	11·75	2·954
Ladoga, general average	Canada	11	2·29	14·31	3·420
Red Fife "	"	6	2·24	14·00	2·931
Saxonka "	Russia and Canada	3	2·23	13·91	2·454
Kubanka "	Canada	2	2·20	13·77	3·183

The average for the eleven Canadian grown Ladoga specimens is: Albuminoids, 14·31 per cent., the same for the six Red Fife being 14·00 per cent. These figures clearly demonstrate that the Canadian grown Ladoga fully equals the Red Fife variety, as far as gluten is concerned—in fact, slightly surpasses it. Although the samples of Red Fife do not number as many as those of the Ladoga, yet those examined are believed to be typical examples of the best grain—three of them being graded as "No. 1 Hard," by experts. We may therefore state that chemical analysis shows the Ladoga and Red Fife wheats to be almost equal and identical in value.

The Saxonka and Kubanka are both Russian varieties, though four out of the five samples analysed were grown in Canada. Like

most of the Russian wheats they show a very fair proportion of albuminoids. As the number of specimens of these grains examined is much smaller than those of the Ladoga and Red Fife, their averages cannot be viewed in exactly the same light as those of the latter wheats. A further mention of the comparative value of these wheats will be made, however, when speaking of the relation existing between the gluten and the weight of the grain.

Of the remaining varieties, but one sample of each has been analysed. They are all, however, believed to be typical specimens.

The Onega, recently imported from Russia, would appear to be a grain very similar in composition to the Saxonka obtained from that country.

The Red Fern sample was sent by the Citizens' Milling Company, of Toronto, and was spoken of very highly as worthy of growth and encouragement. Judging alone from the percentage of gluten, it appears to be a very desirable wheat, and one that compares favorably, from a chemical standpoint, with Ladoga and Red Fife.

The Clawson is the only winter variety in the series. It is known as a soft wheat, and was analysed in order to show a comparison between hard and soft wheat in the percentage of albuminoids. By its low percentage of nitrogen it takes a rank much below that of any of the varieties hitherto discussed.

Wellman's Fife and Blue Stem are two wheats furnished through the courtesy of Professor Porter, Director of the Minnesota Experimental Station, St. Anthony's Park, Minnesota. They are said by him to be typical samples of the best varieties grown there. Having analysed but one specimen of each it would be unwise to pronounce judgment upon them in emphatic terms, or to draw a close comparison between them and the Ladoga and Red Fife. Suffice it to say, therefore, that the Wellman's Fife equals in composition several of the Red Fife specimens, and that in other respects it bears a strong resemblance to that grain. The Blue Stem, if we may judge from a single analysis, is a much less valuable sort.

EFFECT OF ENVIRONMENT UPON THE PERCENTAGE OF ALBUMINOIDS.

The term environment is intended to embrace all the varying conditions of climate, soil and cultivation. Professor Clifford Richardson, of the Department of Agriculture, Washington, has shown that wheat is the most susceptible of all grains to the influ-

ences of environment. After an investigation extending over several years he says: "The quality of the grain produced in any locality is dependent on several conditions, namely, climate, soil and cultivation. Each of these is made up of several elements." Having made analyses of grain from all parts of the United States he has been able, from the results of the same, to map out that country into divisions—each division having its own peculiar effect upon the composition and physical characters of the grain. The influences which modify the wheat in each of these divisions are discussed, and satisfactory explanations offered to account for such modifications.

Following up this line of enquiry, let us see what the effect has been upon the Ladoga wheat by growing it in the various Provinces of Canada. An inspection of Table I shows us that in seven instances out of eleven there has been a well marked increase in the percentage of albuminoids; one specimon remains practically the same, and three have receded from the amount contained in the imported sample, the probable cause of which will be discussed later on. Taking all the Canadian-grown Lagoda specimens, we obtain an average of 14·31 per cent. albuminoids, as against 12·75 in the imported seed—indicating a well marked increase. Examining the effect produced in the different Provinces we perceive that of the four specimens grown in the North-West Territories only one (No. 3) falls below the imported seed in the proportion of albuminoids. This falling off is, I think, satisfactorily explained by the fact that the wheat was laid by a storm during its growth in August. Prof. Richardson has shown that the composition of a wheat may be greatly modified and its albuminoids diminished by such an interruption in its development. Notwithstanding this sample (No. 3), the average for albuminoids of those grown in the North-West Territories is larger than that of any other Province. (*vide* Table II). Nos. 2, 4 and 5 all show high percentages of albuminoids, especially No. 5, which was grown on Poor Man's Reserve, Touchwood Hills N.W.T. This sample contains the largest amount of gluten of any of the series.

The average for the Manitoba samples stands about mid-way between that of the North-West Territories and the quantity possessed by the Russian seed—though two of the samples fall below the latter. Unfortunately no data have been received respecting the conditions of growth of these two samples (Nos. 6 and 7), and con-

sequently it is impossible to advance reasons why the albuminoids should have decreased to such an extent in them. Leaving these two exceptionally low samples out, the Manitoba grain stands equal to that of the North-West Territories.

The albuminoids of the Nova Scotia samples also show an increase over the quantity possessed by the original importation, and are a little higher than the average of the four Manitoba specimens. The conditions of growth during last season in that Province, or at all events in the districts where these were raised, were evidently favorable to an improved development of the Ladoga grain.

The sample grown in New Brunswick is practically identical in its percentage of albuminoids with that of the imported seed.

The effect of environment on the Red Fife cannot be as well studied as in the case of the Ladoga, as we have no imported seed to compare it with. The cases of Nos. 13 and 14 are, however, of particular interest in this connection. No. 13 is a sample from Manitoba, and No. 14 is seed grown from it in Ontario. In the course of one year's growth it is seen that in this instance the albuminoids have diminished when grown in Ontario. Whether this would still further continue by successive croppings in this Province remains yet to be proved. It indicates, however, that in the North-West the conditions are more favorable to the perfecting of this grain, and that like all wheats it is susceptible to change of conditions. As might be expected, the samples of Red Fife show smaller fluctuations in their albuminoids than do those of the Ladoga, having had many years in which to adapt itself to its environment, and the average of 14·00 per cent. for albuminoids no doubt represents fairly its quality.

The Saxonka also shows improvement when grown in the North-West. No. 20, grown at Crooked Lake Reserve, Broadview, N.W.T., is the seed of No. 19, imported from Russia.

The same remarks, though in a modified manner, apply to the Kubanka. Though Nos. 22 and 23 bear no relation to one another, yet the sample grown in Manitoba possesses a larger proportion of albuminoids than that raised in Ontario. We have thus seen that in every case examined a decided improvement has occurred when the grain is grown in Manitoba and the North-West Territories, and particularly in the latter. Granting that the cultivation in these Provinces is about the same as in the older one—Ontario—and in Russia, we have to look for the explanation of such an increased

absorption of nitrogen in either the peculiarities of the climate or the composition of the soil. As yet sufficient data are not to hand to justify one in drawing conclusions as to which of these causes effect the wheat most, though undoubtedly both contribute towards that end. The prairie soil of the North-West has long been noted for its exceptional fertility and its almost inexhaustible store of available plant food. But this of itself is not sufficient to account for the uniform difference observable between the wheats of Ontario and the North-West, and it is quite probable that Prof. Richardson is correct in his deduction when he says of the United States grain, that a high ripening temperature together with a short period of growth produces a grain with a relatively higher percentage of albuminoids than a long period of growth and moist climate—which latter conduce to the development of a plumper grain with a greater abundance of starch.

RELATION BETWEEN THE WEIGHT OF ONE HUNDRED AVERAGE GRAINS AND ALBUMINOIDS.

The weight of a grain of wheat depends on its size and its specific gravity, or density. Thus, it is easy to imagine that we might have a small grain of a close, hard texture that would equal, or perhaps surpass, in weight a much larger grain of a less density. The main difference between a hard and a soft wheat is that the former is richer in albuminoids while the latter contains more starch. This larger percentage of starch would lower the specific gravity of the grain,* and we should expect to find, bulk for bulk, the soft wheat the lighter grain. Let us go one step further. From what has already been said it is apparent that if we were comparing a hard and a soft wheat, both having grains of an equal size, the weight of 100 grains of the former would exceed that of 100 grains of the latter; but if, as is often the case, the soft wheat possessed the larger grain, then it might happen that the excess of starch made up for the difference of albuminoids, and the softer wheat per grain prove heavier.

From the foregoing we should predict that a ratio would be found to exist, when comparing different samples of the same wheat among themselves, between the weight of the grain (or 100 grains) and the albuminoids, and that the greater the weight the larger the percentage

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* This has been experimentally proved. Thus, the specific gravity of No. 2 is 1·333, while that of No. 26 is 1·269.

of albuminoids and *vice versa*. That this law—if so it might be called—would not hold good when comparing wheats of different varieties is obvious from the fact that the normal size and composition of all wheats are not alike. In discussing the relative values of any two or more kinds, even if they be all hard wheats, cognizance must be taken of this fact. One more point has to be noticed in this connection. Suppose that two wheats, the one small and the other large in grain, are identical in composition, the larger wheat would be the more valuable, because measure for measure it would yield more flour and less bran than the smaller grain.

Having made this preliminary explanation, let us first see if any ratio exists between the weight of the average grain and the percentage of albuminoids in the Ladoga wheat. An inspection of Table I shows that there is a well-marked tendency for the albuminoids to increase with the weight of the grain. Thus Nos. 2, 4, 5, 8 and 9 contain a percentage of albuminoids over 15·00 per cent. and the weight of 100 of their average grains is equal to or exceeds 3·450 grams; while the remaining six have less albuminoids than 15·00 per cent. and the weight of 100 of their grains falls below in every case 3·450 grams. The original seed, which is not included in the above comparison, also shows this rule to be true.

Comparing the Red Fife samples among themselves, we notice, first, that there is more uniformity both in the weight of the grain and the percentage of albuminoids, and the differences being but small it is not a matter of surprise that this principle should not be so strikingly exhibited among them. The greatest difference between the two extremes in the weights of 100 of their average grains is but .4 of a gram, while in the Ladoga the same difference is over .8 of a gram. It is more than probable that if as many samples of Red Fife had been examined as of the Ladoga, this relation of weight of grain to gluten would have been more apparent.

In the case of the Saxonka and Kubanka, both recently imported grains, we see this ratio well exemplified, though with an exception in the Saxonka.

The four averages at the foot of Table II are very instructive. The Ladoga ranks first, both as to albuminoids and the weight of the grain, the Red Fife taking a second place, for the reason that it is slightly lower in its albuminoids and somewhat less in the relative weight of the grain. The Kubanka, of which unfortunately we

have only two examples to average from, is slightly lower in its albuminoids; but one of the samples being an exceptionally fine one as to size, the weight of its average grain is a trifle higher than that of the Red Fife. The Saxonka presents the smallest weight for 100 of its average grains, while its albuminoids are almost identical with the Red Fife. This may be readily explained, that like the other three of this series it is a hard wheat, but has a very small grain. The albuminoids in a wheat grain exist in a greater percentage in the outer coats. While, therefore, measure for measure, or weight for weight, the smaller grain yields more bran and less flour than the larger, the percentage of albuminoids in the *whole* grain may be equal in both cases. And further, where a variety of wheat has a very thick skin, such as the Kubanka (which produces less flour and more bran from a given weight than most other sorts), the percentage of albuminoids which would be found in the flour may be materially less than that shown to be contained in the whole grain.

WATER.

Taking an average of the water contained in the twelve Ladoga samples we obtain the figure 8·09; the six samples of Red Fife in like manner give 9·27.

In Bulletin No. 4, Department of Agriculture, Washington, Prof. C. Richardson has shown a special feature of spring wheats to be their *dryness.* Thus, on page 57 of the above bulletin he gives the average water contained by eight Eastern States flours as 12·49 per cent., while the same for Minnesota and Dakota flours is 8·96 per cent. From these figures he rightly deduces that "other things being equal, a barrel of Western flour would make more bread than a barrel of Eastern." This is certainly an important factor in the consideration of the value of flours.

Arguing from the same premises, we conclude that a given weight of the Ladoga flour will make more bread than the same weight of Red Fife. It remains to be seen by an actual test of the bread-making powers of these two wheats whether this conclusion is borne out. The difference, however, between these two cannot be so great as between fall and spring flours, as the percentages of water more closely approximate each other in Ladoga and Red Fife than in the case of wheats known as fall and spring varieties.

DIRECT ESTIMATION OF GLUTEN IN THE FLOUR OF RED FIFE AND LADOGA WHEATS.

This operation consists in washing away the starch, the cohesive residue being dried in a water-oven until thoroughly dry, and weighed. This crude gluten consists of several closely allied albuminoids, chiefly gluten-fibrin, gliadin and mucedin, besides small quantities of fat and mineral matter.

It has been shown by M. Bertrand (Compt. rend. xcvii, 496) that the same flour will yield different proportions of this gluten according to the method of operation and amount of washing. I shall therefore outline the process which I have used.

Ten grams of the flour were weighed out and kneaded into a dough with 5 cubic centimetres of water. This dough was then washed with successive portions of 50 cubic centimetres of water until the wash-water was free from starch. The crude gluten so obtained was spread out on a watch glass and dried in the water-oven until the weight was constant. To get figures as nearly correct as possible, four determinations of the gluten of each flour were made, and the mean of the resultant figures taken. They are as follows:

	Dry Gluten.
Ladoga	15·26 per cent.
Red Fife	15·35 "

From the nature of the operation, this direct determination of gluten must not be considered as accurate an estimation as that of the "albuminoids" obtained by multiplying the percentage of nitrogen by 6·25. For, as already stated, the proportion of gluten thus found varies according to the mode and time of procedure. Nevertheless, it forms confirmatory evidence as to the similarity in composition of these wheats, and together with the analytical data before given, bears out what I have said when discussing the relative value of Red Fife and Ladoga wheats in respect to the amount of albuminoids or gluten they possess, as determined by chemical analysis.

The flour used for this direct determination of gluten was not in either case made from wheat which had been analysed. The Ladoga flour is from grain grown on the Experimental Farm, at Indian Head, during the summer of 1888. The flour of the Red Fife was furnished by grain grown on an adjoining field, yielding a

crop of 40 bushels to the acre, the wheat being of excellent quality, and graded "No. 1."

ASH.

The mineral constituents of the wheats are denoted under the term ash. Time did not allow of the detailed analysis of such; but as Prof. Richardson has shown that among the chief constituents, viz., phosphoric acid, potash and magnesia, there is but little variation for different wheats, this is not a matter of vital importance.

The average of the ash of the four principal varieties analysed is here tabulated :—

AVERAGES OF ASH.

NAME.	Number of Analyses.	Per Cent. of Ash.
Ladoga	12	1.81
Red Fife	6	1.62
Saxonka	3	1.74
Kubanka	2	1.75

Whether the Red Fife, when it was first introduced into the North-West, contained a larger percentage of ash cannot, of course, be said. As they stand to-day, it would appear that the Russian varieties, and particularly the Ladoga, have the property of assimilating from the soil larger quantities of mineral food than the Red Fife. This may be an inherent property in the wheats, or due, in this case, to more favorable environment than they formerly enjoyed. The original Ladoga seed, however, contains 2·00 per cent. ash, which would go to show that the grain, as grown in Russia, has a higher percentage of ash than when grown in the North-West. The same also appears in the case of the Saxonka. If, then, the contrary of what has been said is true, and the Russian wheats take less mineral matter from the soil when grown in the North-West, we have to look for an explanation in either the composition of the soil or in the climate which regulates, to such a great extent, the growth of the wheat plant. This interesting feature deserves further investigation.

FORM, OR APPEARANCE, AND RELATIVE HARDNESS OF THE WHEATS.

The Ladoga is a red wheat, plump, and semi-translucent. The grains, on an average, are slightly longer than those of the Red Fife, and none of the better samples possess those opaque spots

which betoken the presence of an increased development of starch. The figures show that the individual grain weighs heavier than that of the Red Fife. The Red Fife is also a red wheat, but even the best samples are not free from those spots of opacity just mentioned. In general characteristics these two wheats bear a very strong resemblance to one another. The Kubanka is yellower in color than either of the preceding, and is certainly the hardest of the series. Its grain is long, and has the semi-translucency more marked than that of either Ladoga or Red Fife. Saxonka, as already stated, is a very small wheat, red in color, and not very "bright" in appearance. The Red Fern is also a small wheat, of a dark red color, and is not quite as hard as either Red Fife or Ladoga. Clawson is a yellowish white variety, and very soft. Its grains are of a very fair size, and plump. The Onega is small in grain, and dark red of color. Wellman's Fife and Blue Stem are both red wheats, the former the larger of the two. Neither is free from opaque spots, the Blue Stem predominating in this respect.

COMPARISON OF LADOGA AND RED FIFE WITH SOME AMERICAN WHEATS, AS ANALYSED BY PROFESSOR C. RICHARDSON.

In Bulletins Nos. 1, 4 and 9 of the Department of Agriculture, Washington, D.C., Professor Richardson gives the results of a large number of analyses which have been made of wheats grown in many of the States of the Union. The series extends over several years, and both the analyses and the deductions drawn from them prove the exhaustive manner in which the whole question of the physical properties and chemical composition of wheat, as grown in the United States, has been treated by the author.

In concluding this bulletin, therefore, I think it will be of interest to compare some of these results with those of the present investigation.

The following are abstracted from the table on page 30, Bulletin No. 4, Division of Chemistry, Department of Agriculture, Washington, 1883-84.

Locality.	Number of Analyses.	Weight of 100 Grains	Albuminoids, N × 6·25.	Ash.
United States and British America.....	407	3·644	12·15	1·92
Atlantic and Gulf States..................	117	3·489	11·35	1·77
Middle States..................................	91	3·537	12·50	1·85
Western States................................	177	3·763	12·74	2·06
Pacific States..................................	20	4·091	9·73	1·87
Canada..	6	3·325	10·87	1·56
Minnesota..	13	3·245	13·19	1·77
Dakota...	12	3·149	14·95	1·96
Manitoba..	2	3·288	14·53	1·63

The following are from Table II of this Bulletin, and inserted for comparison with the above:—

Locality.	Number of Analyses.	Weight of 100 Grains	Albuminoids, N × 6·25.	Ash.
Canada Ladoga................................	11	3·420	14·31	1·81
" Red Fife................................	6	2·931	14·00	1·62

By reference to the table on page 20, Bulletin 1, we see of the six varieties of Canadian wheat analysed five were soft winter wheats, the remaining being Imperial Fife. I have already pointed out that the soft wheats contain very much less gluten than the hard, and thus we see how it comes about that the average of 10·87 per cent. albuminoids is here given for Canadian wheat.

If the quantity of soft wheat raised in Canada in 1883 was in excess of hard grain, and this average fairly represented Canadian wheat at that time, it certainly does not do so now; for of late years the growth of Red Fife has greatly increased in Manitoba and the North-West Territories.

The two samples of Manitoba wheat analysed by Prof. Richardson give an average in albuminoids slightly in excess of our results for Red Fife. Taking the Minnesota and the Dakota samples together, we obtain an average of 14·07 per cent. albuminoids—practically identical with our determinations for Red Fife. The

grain grown in Minnesota and Dakota is the richest in gluten of that raised in the United States.

CONCLUSIONS.

1. That as far as gluten is concerned (as determined by chemical analysis) the Red Fife and the Ladoga are almost equal in value, with a small balance in favor of the latter wheat.

2. That a very well marked improvement has taken place in the Ladoga wheat by its growth in Canada, and particularly in the North-West, and that the same appears to be true of other Russian varieties.

3. That there appears to be a direct relation between the percentage of albuminoids and the weight of the grain, viz., the heavier the individual grain the greater the proportion of albuminoids.

4. That with respect to size, weight and hardness of the grain the Ladoga compares very favorably with the Red Fife, and judging from the samples analysed, ranks above this grain in these features.

5. That the Manitoba hard wheats (Red Fife and Ladoga) most certainly equal in value the best grown in the States of Minnesota and Dakota, and this deduction is made both from my own and Prof. Richardson's results.

6. That from a mechanical estimation of gluten in the Ladoga and Red Fife flours, the conclusion may be drawn that in the possession of this valuable constituent these flours are almost equal.

CENTRAL EXPERIMENTAL FARM,

DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - CANADA.

BULLETIN No. 5.

AUGUST, 1889.

To the Honourable the Minister of Agriculture :

Sir,

I have the honour to submit for your approval the fifth Bulletin of the Central Experimental Farm, which has been prepared under my direction by Mr. W. W. Hilborn, Horticulturist of the Central Experimental Farm.

The cultivation of small fruits, but particularly that of the Strawberry, has of late years engaged the attention of a large number of fruit growers and farmers in Canada, many of whom have found in this occupation a considerable source of profit. The fact that this useful fruit can be successfully grown in almost every settled part of the Dominion, makes it important that practical information regarding the best methods of cultivation and the most profitable varieties to grow, should be widely disseminated. The information submitted herewith by the Horticulturist contains the conclusions reached by him from long experience as a practical fruit grower, and embodies also the results of the tests and observations which have been carried on for the past two years at the Central Experimental Farm, during which period all the varieties of strawberries named and described in the Bulletin have been carefully tested.

The principles which underlie successful strawberry culture for market purposes are duly set forth, also the best methods of growing strawberries for home use on the farm. By adopting the methods of cultivation here recommended, every farmer could with very little labour, furnish his household with an ample supply of delicious fruit for several weeks during the heat of early summer when such an addition to the diet is most healthful and necessary.

Most of the figures used in this Bulletin have been engraved from photographs of berries grown on the Experimental Farm, and show the exact size of good samples of the several varieties.

I have the honour to be,
Your obedient servant,

WM. SAUNDERS,
Director.

Ottawa, 12th August, 1889.

Central Experimental Farm.

:o:

DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - CANADA.

STRAWBERRY CULTURE.

By W. W. Hilborn,
Horticulturist, Central Experimental Farm, Ottawa.

The strawberry can probably be grown over a larger area than any other fruit, hence it is scarcely practicable to give any one method of cultivation which will be entirely satisfactory in every locality. There is so much variation in climate, soil, etc., in different parts of the Dominion, that the system of cultivation must be varied to some extent to suit the circumstances. This plant requires a cool, rich, soil, moist, but not wet, with room to grow. The weeds must be kept down and protection afforded from sudden changes of temperature, resulting in alternate freezing and thawing during the winter and early spring. If these conditions are secured and suitable varieties planted, success is almost sure to follow.

SOIL

Any soil that will produce a good crop of potatoes or other vegetables will answer for strawberries. It should be well drained, either naturally or by tile drains. A rich clay loam is preferable and will usually give the largest yield, but the fruit will not ripen as early as on sandy loam. Avoid if possible a stiff, heavy clay. While a clay loam will give the best results if properly managed, it will not prove satisfactory unless it is well drained and the soil thoroughly prepared in the autumn previous to planting.

PREPARATION OF THE SOIL.

For profitable growing on a large scale, select a piece of well drained clay loam. This should receive a heavy coating of manure in the spring and then be either summer-fallowed or planted with potatoes, vegetables, or some other early crop which can be removed in time to permit of a proper preparation of the land in autumn before it becomes too wet with fall rains. A sub-soiler should follow the common plough, one that will stir up the sub-soil to the depth of five to ten inches without bringing any of it to the top. Subsoiling is not absolutely necessary, but land thus loosened up will retain moisture longer in time of drought and dry off much more rapidly after heavy rains. The last ploughing in the fall should be thoroughly done and suitable furrows provided, so that all surface water may run off quickly. Early in the spring, as soon as the weather and the condition of the soil will permit, cultivate deeply both lengthwise and crosswise with a two-horse cultivator; harrow down smooth and the land will be ready for planting. Avoid ploughing a heavy soil in the spring for immediate planting.

Gravelly or sandy loam should be heavily manured in the spring, and may be planted with vegetables. All weeds should be kept down during the summer. Plough in the fall and again in the following spring, and harrow thoroughly. No subsequent tillage will make up for inadequate preparation of the soil for strawberry culture. A stiff clay loam is more difficult to manage. A crop of clover or other green manure turned under will help to make the soil more friable. Coarse barnyard manure should also be used whenever it can be applied in time to decompose and become well mixed with the soil before planting. Tile drains in such soil require to be much nearer together and should not be too deep, usually not much more than two and a-half feet. In the autumn, before the land becomes too wet, trench it up in high narrow ridges; if done with the plough, turn two furrows together forming a sharp ridge as when prepared for carrots or other roots. Surface drains should be made to take off surplus water quickly. When thus exposed to the action of the frost, a comparatively heavy soil will work down fine and mellow in the spring and give good results. Care must be taken, however, never to stir such soil when wet, either with hoe, plough or cultivator.

TIME TO PLANT.

Plant as early in the spring as the land can be prepared, as this gives

the whole season for growth, and enables the plants to produce a full crop the following year. Fall planting, if done in August, will yield a small crop the following spring, but seldom enough to pay for the extra labour required. The principal objection to fall planting is that the plants do not make sufficient root growth to prevent them from lifting in the soil with the repeated freezing and thawing to which they are exposed during the winter and early spring. In any locality where no difficulty is likely to occur from this cause, autumn planting may often be praticed with advantage.

METHODS OF PLANTING.

Several different systems have been practiced successfully. The method of planting should be regulated by the quantity of land to be used, the amount of labour and manure at the disposal of the planter, the varieties to be planted, whether for market, or for a city garden, or on the farm for family use.

HILL SYSTEM.

For a city garden, where land is usually scarce, the hill system will generally give very satisfactory results. Plant in rows two feet apart and twelve to fifteen inches apart in the row. Cut off all runners before they have time to take root, thus enabling the plants to make strong stools or hills by the end of the growing season. Any blossoms which appear the same season of planting should be removed. In an unfavorable locality, where much alternate freezing and thawing is likely to occur during winter and early spring, growing in hills is not always successful, as they are more likely to heave with the frost, and the plants do not afford the same protection to each other as when planted in matted rows.

MATTED ROWS.

For this mode of culture, the rows require to be from two and a-half to four feet apart, and the plants twelve to fifteen inches apart in the row. Cut off any blossoms which may appear, also the first runners, until the plants have gained sufficient vigor to send out several strong runners at once, when they should be allowed to take root and form a matted row from six to twelve inches in width. All free growing sorts make too many plants and should have all surplus runners cut off. The plants should not be crowded in the row. From three to six inches apart each way will give the required protection to each other and room to produce fruit of large size and in abundance.

GROWING STRAWBERRIES ON THE FARM FOR FAMILY USE.

There is probably no other class of the community so poorly provided with this fruit as farmers. This should not be the case, as strawberries can be grown with so little expense and trouble, that no one who has land should be without a sufficient supply. Much difficulty has been experienced by some in keeping up a strawberry plot for family use, for the reason that the usual method has been to plant strawberries in some out-of-the-way corner or enclosure where all the work has to be done by hand, and where they rarely get any attention after the first season, except to gather such fruit as may ripen. By the end of the third season the plants will generally be so exhausted, that but little fruit is produced, and the young plants seldom possess that vigor required for starting another plantation successfully, hence they are often given up as too troublesome.

If the following system is adopted, a crop of strawberries can be grown as easily as one of potatoes and with as little risk of failure :—Select the best piece of land procurable, where the plants can be cultivated with a horse cultivator in the same manner as corn or potatoes. For a family of ten or twelve persons, four rows two hundred feet long will give an ample supply for from three to five weeks, if suitable varieties are selected and reasonable cultivation given. Suppose the plot chosen to be forty feet wide and two hundred feet long. Plant four rows, covering one-half of the plot, as early in the spring as possible, four feet apart and one foot apart in the rows.

Cut off all the blossoms and first runners until the plants have sufficient strength to send out several strong runners at once (which is usually in July) when these may be allowed to take root. Stir the soil occasionally with the cultivator and keep the ground free from weeds. The second half of the plot should be well manured and planted with potatoes, and after these are dug in the fall the land should be prepared for planting in the following spring. Plants of the best quality can be obtained from those first planted for this second plot. By following this system a full crop of fruit can be gathered in about fourteen months from the time of planting.

As soon as the last berry is picked, plough up the first plantation, add manure and again prepare the land for planting the following spring. But one crop of fruit is taken from the plants and less time is required in putting out a new plot every spring than in cleaning out the old one. With this method there is no difficulty in keeping

up a supply of strong and vigorous plants for replanting—a most important point in successful strawberry culture. A plantation can be made to bear well for several seasons by cleaning out the rows as soon as the last fruit is gathered, cutting them down to about six inches in width and giving thorough cultivation until the autumn; but more experience is required to manage the plants under this method than with the renewal plan.

One row each of the following varieties:—Crescent, Wilson, Captain Jack, and Manchester, will make a collection that will give a succession of fruit for a month in a favourable season. In any locality where other sorts are known to succeed and are more easily obtained, they can be used in place of those named. It is of great importance to procure plants as near home as possible, or from those who will take much care in packing them. Failure is often due to the careless handling of the plants while out of the ground or to want of care in packing them.

PLANTING.

After the land has been well prepared, mark off with a corn marker, or stretch a line to plant by. Take pains to have the rows straight; it adds to the appearance of the plot and time is also saved in the cultivation. Trim off all dead leaves and old runners from the plants; shorten the roots to three or four inches, keep them moist and where the wind cannot reach them while out of the ground. When planting, make a hole deep enough to admit the roots without doubling them up. Take the plant in the left hand, place the crown on a level with the surrounding soil, spread the roots out fan shaped, fill in the soil, working it in among them, and press so firmly that by giving a quick jerk on a leaf it will break off without moving the plant. Only plants of the previous year's growth should be used.

Fig. 1.

Fig. 1 shows the correct way of setting the plant. In fig. 2, the roots are all in a bunch instead of being spread out evenly as in fig. 1. They cannot, therefore, make such a vigorous growth. When planted too deep, as in fig. 3, they are nearly always smothered and will rot off at the crown. In fig. 4, the crown is above the level of the surrounding soil and therefore too high. When thus planted they generally wither and die in a few days.

Fig. 2.

Fig. 3.

Fig. 4.

CULTIVATION.

Nearly all soils are full of weed seeds. When these germinate and appear above ground, cultivation should begin. Frequent stirring of the soil will destroy these weeds, and during drought will cause sufficient moisture to be retained in the soil to enable the plants to make a strong growth,

Never allow weeds to grow in the strawberry patch. Cultivate carefully and thoroughly. By running the cultivator the same way every time, the plants that are newly rooted will not be so readily disturbed. Care must be taken not to stir the soil immediately around the plants, especially early in the season, as this is often the cause of their making feeble growth.

MULCHING.

The crop of strawberries will very much depend on how well the plants have been protected during the winter and early spring. It is not the severe freezing that injures the plants so much as the oft. repeated freezing and thawing. The use of a mulch of coarse manure, marsh hay, or clean wheat straw, is most effectual in preventing injury from this cause. Oat straw generally packs too closely and does not admit air freely enough to either soil or plants, especially on heavy land. As soon as the ground freezes in the autumn sufficiently hard to prevent horses and waggon from breaking through the crust, the mulch should be applied. Most of the material should be placed between the rows with just enough immediately over the plants to nearly cover them from sight. Before growth begins in the spring, draw the covering off from the plants and let it remain between the rows until after the fruit has been gathered; it thus serves the triple purpose of keeping the fruit clean, the soil cool and causes it also to retain longer the moisture gathered early in the

season—which is all important to the production of a large crop of fruit.

In localities where late frosts are likely to occur at the time of blossoming, the mulch should be removed just before growth begins in spring and very shallow cultivation given. The soil becomes warmer when thus loosened and the blossoms often escape a frost, when the land is thus treated, which would otherwise injure them to a considerable extent.

BLOSSOMS.

Fig. 5. Bi-sexual.

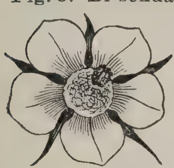


Fig. 6. Pistillate.

Strawberry blossoms are divided into classes, 1st, bi-sexual or perfect. These contain stamens or male organs, and pistils or female organs, as in fig. 5, hence are called perfect or bi-sexual, marked thus (B). 2nd, pistillate or imperfect, which contain pistils only, or female organs, as in fig. 6. Pistillate varieties usually yield the largest crops of fruit when properly fertilized. This may be done by planting one or more rows of a perfect-flowering sort to every four or five rows of those with imperfect blossoms.

LIST OF VARIETIES.

Fig. 7. Atlantic.

ATLANTIC (B).—Fruit medium to large, conical, bright dark crimson, of good quality, nearly or quite as firm as Wilson. Season medium to late. Plant a strong grower and quite productive; sometimes the foliage is injured by rust; worthy of a more extended trial.

Fig. 8. Annie Forrest.

ANNIE FORREST (B).—Fruit large, conical, bright scarlet, colours on all sides at once, medium to good quality, firm as Crescent; medium early. Plant a vigorous grower and quite productive; worthy of trial for market.

AMATEUR (P).—Fruit of large size, round, light scarlet, good quality, not firm enough for market. Plant a strong grower, quite productive; often suffers from rust; of value only for the amateur.

BIG BOB (P).—Fruit of large size, bright scarlet, good quality. Plant only moderately vigorous; sometimes productive; not usually reliable.

Black Giant (B).—Fruit large to very large, often irregular in form, very dark red, seeds quite prominent, the large berries are apt to be hollow in the centre; of good quality. Plant only moderately vigorous; not very productive.

Belmont (B).—Fruit medium to large, conical or egg-shaped, good quality, dark crimson, quite firm. Plant quite vigorous, but not productive enough to be valuable either for home use or market.

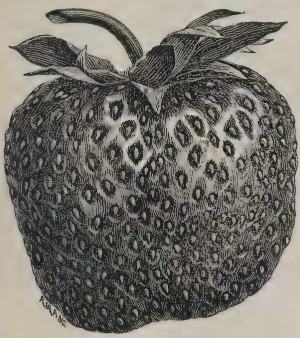


Fig. 9. Bubach.

Bubach (P).—Fruit large to very large, roundish or broadly conical in form, sometimes uneven on the surface, but never misshapen; bright red; quality medium to good, not firm enough for distant market; ripens medium early. Plant very strong and vigorous, foliage healthy and withstands the hot, dry weather remarkably well; very productive. All points considered, it is one of the best sorts tested here for a near market or home use.

Bancroft (P).—Fruit of medium to large size, somewhat of the Manchester type. Plant not vigorous or productive enough to make it of any special value.

Boyden (B).—Fruit medium to large, dark red, good quality. Plant not vigorous nor is it productive enough to make it valuable.

Bright Ida (B).—Fruit medium to large, bright scarlet, medium quality. Plant vigorous and productive. Succeeds best on a rich loam. Blooms early and is therefore liable to injury by late spring frosts.

Bordelaise (B).—Fruit small to medium, conical very dark red, almost a purple when fully ripe; very good quality; it has a very high musky flavor that is much admired by some. Plant vigorous and healthy; not very productive. It is a foreign variety of the Hautbois type and one of the best of its class.

Bidwell (B).—Fruit large to very large, ovate conical in form, sometimes irregular; colour light crimson, becoming quite dark when fully ripe; of good quality; flesh moderately firm. Plant strong, vigorous and productive; succeeds best on rich clay loam, with very narrow row or hill culture.

Fig. 10. Crescent.

CRESÇENT (P).—Fruit medium to large, conical, colour bright scarlet; colours on all sides at once, which is a great advantage in gathering the fruit; only medium in quality; flesh moderately firm if it is not allowed to become too ripe; season early to medium late Plants very vigorous and multiply rapidly; should not be allowed to mat too closely for best results. The most productive of any variety yet fully tested; one of the best for home use or market.

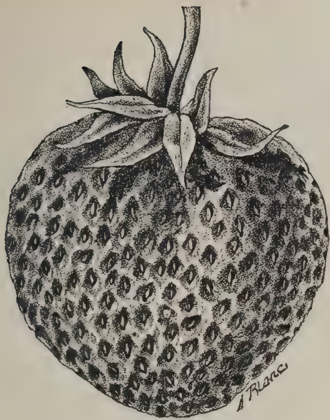


Fig. 11. Captain Jack.

Captain Jack (B).—Fruit medium to large, of regular form; bright red in colour, medium quality, fully as firm as Crescent; season medium to late. Plant strong and vigorous, very productive, succeeds best on a rich clay loam, valuable for market or home use.

Cornelia (P).—Fruit large, of regular form, colour red, quality medium, ripens late. Plant not vigorous or productive, subject to rust.

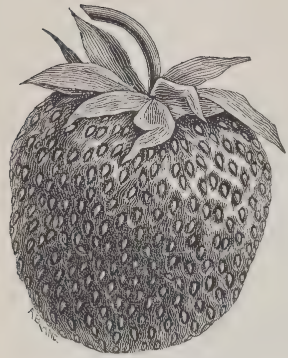
Cumberland (B).—Fruit large to very large; form ovate conical, regular and uniform; colour light red; of good quality; flesh moderately firm; season medium. Plant strong, vigorous and moderately productive.

Connecticut Queen (B).—Fruit medium; colour, a dull greenish red, unattractive; good quality; season medium to late. Plant very vigorous, not very productive.

Charles Downing (B).—Fruit medium to large, conical, good quality, not firm enough for market. Plant a strong grower, but very much affected by rust, moderately productive.

Covill (B).—Fruit large at first picking, but does not hold out well in size later in the season, colour dark red, good quality, ripens very early. Plant strong, vigorous and quite productive, should be grown on rich soil, in narrow rows, its earliness will make it valuable for market, ripening as it does, several days ahead of Crescent.

Cjampion (B).—Fruit of medium size, conical, light red, medium to good quality, moderately firm, ripens medium to late. Plant a strong grower, quite prcductive, suffers considerably from rust.

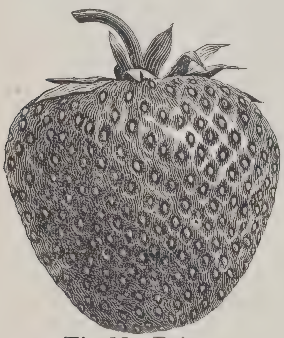


CRAWFORD (B).—Fruit large to very large, bright scarlet, colours up on all sides at once; medium to good quality, quite firm; season late to very late. Plant strong and vigorous with healthy foliage, quite productive; worthy of trial for near market and home use.

Fig. 12. Crawford.

DANIEL BOONE (P).—Fruit medium to large, conical; colour bright red; good quality, not very firm when fully ripe; season medium. Plant strong and vigorous, foliage suffers from rust to a considerable extent; moderately productive.

DOWNER'S PROLIFIC (B).—Fruit medium to large; colour light red; medium to good quality, not firm enough for market; ripens medium early. Plant a strong grower, but suffers from rust; productive.



DAISY (P).—Fruit large; colour bright red; medium to good quality, quite firm; ripens medium early to late. Plant quite vigorous and productive; worthy of an extended trial for market and home use.

Fig. 13. Daisy.

EMERALD.—Blossoms nearly pistillate. Fruit of medium to large size of the Manchester type; colour light red; medium in quality and in firmness. Plant is not a strong grower and suffers from rust to such an extent that it is of little or no value here.

EXCELSIOR (P).—Fruit medium in size, round, poor quality, not firm enough for market. Plant vigorous and productive.

EARLY CANADA (B).—Fruit medium in size, very dark red, quite acid, flesh firm; season early. Plant only moderately vigorous, suffers badly from rust. It blossoms very early, and is, therefore, more liable to injury by late spring frosts.

Enhance (B).—Fruit large to very large, very irregular in form; colour dark red; poor to medium; flesh firm; season medium to late. Plant very vigorous and hardy, very productive.

Fairy (P).—Fruit medium in size; colour nearly white in the shade, when fully ripened in the sun the berries are a pretty pink; quality good; flesh soft, ripens medium to late. Plant vigorous and moderately productive.

Gold (P).—Fruit large, nearly round, of regular form; colour bright scarlet; quality good to very good; flesh firm; season medium to late. Plant only moderately vigorous, rather tender, requires to be well protected; fairly productive.

Gandy (B).—Fruit medium to large; colour bright red; flesh firm, medium to good quality; season late to very late. Plant very vigorous and quite healthy, only moderately productive.

Green Prolific (P).—Fruit medium to large, light red, medium in quality, too soft for market. Plant a strong grower, productive, suffers much from rust.

Golden Prolific (P).—Fruit medium to large in size, round, slightly conical; colour bright red with golden seeds, of very fine appearance. Plants vigorous but only moderately productive; where it succeeds it is one of the best for table use.

Grand Duke (P).—Fruit of medium size, and good quality. Plant only moderately vigorous and productive.

Haverland.—Blossoms nearly pistillate; fruit large, of regular conical form, bright scarlet; quality medium; flesh not very firm; season early to late. Plant very strong and vigorous; very productive; fruit stocks rather weak. This variety is worthy of trial for a near market.

Hampden (P).—Fruit medium to large; form oblate conical; colour dull red, quite acid. Plant is not vigorous enough to be of much value.

Hoffman (B).—Fruit small to medium, quite acid. Plant quite a strong grower, suffers somewhat from rust. This variety is not of any special value.

Henderson (B).—Fruit large, pyramidal with neck; colour bright red, does not ripen evenly, very good quality. Plant only moderately vigorous and productive, of no value for market.

Itasca (B).—Fruit medium in size, good quality. Plants quite vigorous in growth, but unproductive. The blossoms of this variety

are not very well supplied with pollen, the stamens drop off soon after the flower opens, which gives it the appearance of a pistillate sort.

JUMBO (B).—Identical with Cumberland.

JAMES VICK (B).—Fruit medium in size; bright glossy red; medium quality; quite firm. Plant very strong, vigorous and healthy; requires to be grown in very narrow matted rows, or in hills, otherwise the fruit will be too small.

Fig. 14. Jewell.

JEWELL (P).—Fruit large to very large; colour beautiful bright scarlet; medium in quality, moderately firm for a large berry; season medium to late. Plant strong and vigorous, produces but few runners; suitable only for narrow row or hill system; very productive.

JERSEY QUEEN (P).—Fruit large to very large; colour scarlet; good quality, moderately firm; season late. Plant healthy, only moderately vigorous; fairly productive.

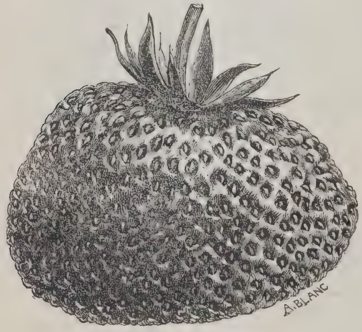


Fig. 15. Jessie.

JESSIE (B).—Fruit medium to very large in size, irregular in form. bright crimson, good quality, flesh quite firm; season medium early. Plant a strong grower, only moderately productive.

This variety has not come up to expectation in this locality.

KENTUCKY (B).—Fruit medium to large, rather light in colour; season late. Plant a strong grower, often injured by rust; not very productive.

KING OF THE NORTH.—This variety suffers to such an extent from rust that it is of no value here.

LACON (B).—Fruit large, irregular, dark red, medium quality, quite acid, moderately firm in flesh. Plants grow to an immense size with good cultivation and produce abundantly; does not withstand drought as well as most varieties.

LEGAL TENDER (B).—Fruit small; plant vigorous, only moderately productive.

Fig. 16. Lida.

LIDA (P).—Fruit medium to large, bright glossy red, medium quality; season medium early. Plants only moderately vigorous, but very productive.

LONGFELLOW (B).—Fruit large, elongated, with neck; dark red; good quality, medium in firmness. Plant not very vigorous or productive, does best on rich clay loam.

Fig. 17. Manchester.

MANCHESTER (P).—Fruit large, oblate conical, of regular form; colour light scarlet; good quality, subacid. Plant vigorous and very productive, a good market sort where it succeeds; in many localities the foliage rusts to such an extent that the crop is very much injured.

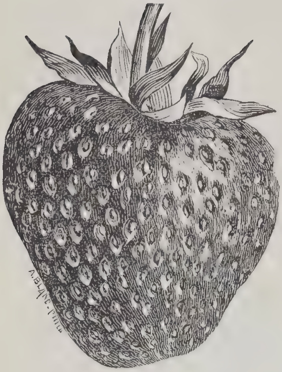


Fig. 18. May King.

May King (B).—Fruit medium in size, conical, light red, with white tip, good quality, flesh quite soft. Plant very healthy and vigorous, not very productive.

Fig. 19. Maggie.

Maggie (B).—Fruit medium to large, sometimes very large, irregular in form; colour dull red; quality medium to good, flesh quite soft, will not bear shipping to a distant market; season early to medium. Plant very vigorous, healthy and productive.

Mary Fletcher (B).—Fruit medium to large; colour dark bright red; good quality; season medium. Plant quite vigorous, moderately productive, foliage often injured by rust.

Mrs. Garfield (B).—Fruit medium to large. Plant not sufficiently vigorous and healthy to be valuable.

Mt. Vernon (B).—Fruit medium to large, oblate conical; red in colour; quality medium, flesh quite firm; season late to very late. Plant very strong and vigorous, quite productive; a valuable late sort for either home use or market.

Montreuil (B).—Fruit very small; dark red when fully ripe; a variety of the alpine; of a peculiar flavour, not admired by the majority of of people.

Mammoth (B).—Fruit medium to very large in size; dark red; good quality; season medium. Plant not very vigorous, suffers much from rust; moderately productive.

Miners' Prolific (B).—Fruit medium to large; dark bright red; good quality, not firm enough for market; season medium. Plant quite vigorous and moderately productive, foliage suffers somewhat from rust.

Mrs. Cleveland (P).—Fruit medium to very large, irregular, scarlet, good quality, flesh moderately firm; season medium to late. Plant strong and vigorous; foliage quite healthy; productive this, its first season on trial at the farm; quite promising.

Fig. 20. Monmouth.

Monmouth (B).—Fruit medium to large, of uniform conical form; bright crimson; good quality, flesh quite firm; season very early. Plant vigorous and healthy, but not large, quite productive, a promising early variety for either home use or market.

New Dominion (B).—Fruit large, oblate conical, regular form; colour bright scarlet; good quality; season late to very late. Plant vigorous in growth, foliage sometimes injured by rust; quite productive, succeeds quite well in this locality.

Norman (B).—Fruit large, conical, colour dark glossy red, good quality; flesh quite firm; season medium early. Plant only moderately vigorous; foliage rusts to some extent; not productive enough for market.

Nicanor (B).—Fruit small, bright red in colour; season early. Plant not very vigorous, moderately productive.

Old Ironclad (B)—.Fruit medium in size; colour crimson; medium quality, flesh quite firm; season early. Plant very vigorous and healthy, not productive enough to be valuable.

Ohio (P).—Fruit medium size; form round, slightly conical; colour bright red; medium quality, rather acid; season late. Plant strong and vigorous, quite productive; foliage injured to quite an extent by rust.

Ontario (B).—Fruit and plants of this sort resemble Sharpless so closely that it appears to be identical with that variety.

PIPERS (B).—Fruit small, dark red in colour, medium quality, quite acid. Plant vigorous and productive; fruit not large enough for market.

PRINCE OF BERRIES (B).—Fruit medium to large in size, dark red in colour, quality very good, flesh dark red, quite firm. Plant only moderately vigorous, foliage healthy, not very productive.

PARRY (B).—Fruit large to very large; form oblate conical, quite regular; colour light scarlet; good quality, moderately firm; season medium early. Plant moderately vigorous, quite healthy, fairly productive; this sort does not appear to be very hardy, requires to be well protected during winter.

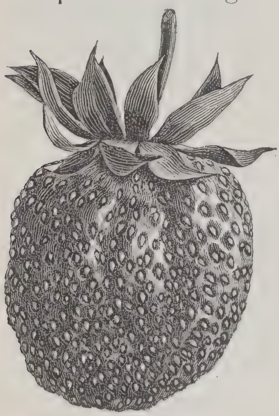


Fig. 21. Pineapple.

PINEAPPLE (B).—Fruit medium to large, irregular in form; colour light red or pink; good quality; somewhat resembling pineapple; not very firm; season medium to late. Plant very vigorous and healthy, sometimes quite productive; not reliable.

PHOTO.—Blossoms nearly pistillate. Fruit large to very large; dark glossy red; good quality, not very firm. Plant only moderately vigorous, foliage suffers to quite an extent from rust.

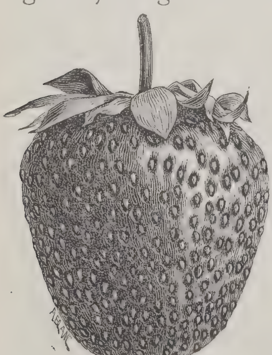


Fig. 22. Pearl.

PEARL (B).—Fruit medium to large in size, obtusely conical; colour bright scarlet; good quality, quite firm; season medium early. Plant a very strong grower, none more vigorous, foliage healthy, very productive, well worthy of trial for market.

Royal Hautbois (B).—Fruit small to medium in size, very dark red or purple when fully ripe; quality very good, of a high musky flavour. Plant quite vigorous and healty, not productive, a foreign variety of little value for this locality.

Ray's Prolific (B).—Fruit medium in size and quality; foliage injured by rust to such an extent that it is of no special value here.

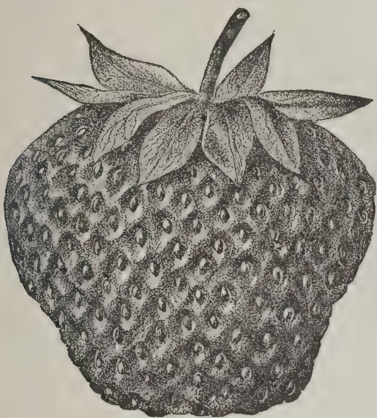


Fig. 23. Sharpless.

Sharpless (B).—Fruit large to very large, irregular in form; colour crimson; good quality, moderately firm; season late. Plant very large and vigorous, foliage healthy; requires rich soil and good cultivation; well adapted to hill culture; blossoms more easily injured by late spring frosts than most sorts.

Seneca Queen (B).—Fruit large to very large, form roundish to flattish; colour very dark red; good quality, quite firm; season medium. Plant very vigorous and productive, succeeds best on sandy loam; on such soil it is one of the best amateur sorts.

Sterling (P).—Fruit large, of regular conical form; colour scarlet; quality very good. Plant not very vigorous or productive, foliage suffers much from rust.

Sunapee (B).—Fruit medium in size, conical; dark red; good quality, firm in flesh; season medium. Plant a strong grower, foliage suffers considerably from rust, not as productive as Wilson, quite distinct in foliage and fruit from that old standard sort.

Shirts (B).—Fruit large, long conical with neck; colour very dark red; good quality, moderately firm; season medium early. Plant not very hardy, nor vigorous, moderately productive.

Summit (P).—Fruit very large; form obtusely conical, never misshapen, very uniform; colour light scarlet; good quality; flesh moderately firm; season medium. The plant is not large and suffers some from rust, moderately productive.

Snow Flake (B).—Fruit medium in size; colour bright scarlet, very white inside, flavor good to very good; season medium. Plant moderately vigorous and productive, valuable only for the amateur.

Surprise (B).—Fruit medium to large; colour dark red; quality good. Plant only moderately vigorous and productive.

Sucker State (B).—Fruit medium in size, bright scarlet, medium quality; plant quite vigorous and productive.

Triomphe de Gand (B).—Fruit large to very large, conical, often flattened; colour glossy crimson; flavor good to very good, flesh quite firm. Plant only moderately vigorous and productive, should be grown on rich soil and in hills.

Vineland (B).—Fruit medium in size, medium quality, season late. Plant moderately vigorous; foliage injured considerably by rust.

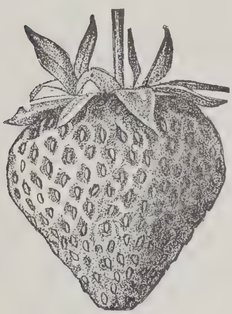


Fig. 24. Wilson.

Wilson (B).—Fruit medium to large, conical, dark red, quality good when fully ripe; as usually gathered for market, it is quite acid; very firm. Plant vigorous and productive; foliage sometimes injured by rust.

This sort should have rich soil and good cultivation; one of the best market sorts.

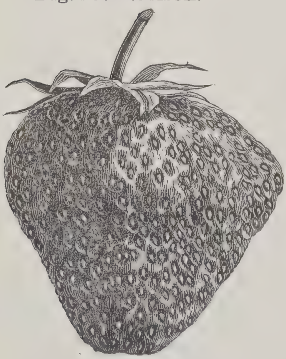


Fig. 25. Woodruff.

Woodruff (B).—Fruit medium to large, irregular in form, often wedge shaped; bright, glossy crimson; good flavour; flesh very firm; season medium early to medium late. Plant only medium in size, but very vigorous and healthy, very productive; well worthy of a trial for market, also one of the best for home use.

Windsor Chief (P).—Fruit medium in size, form round, regular; colour dark red; flavour quite acid, but rich when fully ripe; flesh quite firm. Plant only moderately vigorous and productive; foliage suffers from rust.

WONDERFUL (P).—Identical with Windsor Chief.

WARFIELD'S NO. 2 (P).—Fruit large in size; colour dark red; good quality; flesh quite firm. Plant strong, vigorous and productive; worthy of trial for market.

WOODHOUSE (P).—Fruit medium in size; form conical; colour bright scarlet; medium quality, quite firm; season medium to late. Plant vigorous and productive. This sort is worthy of trial for market, its even size, fine appearance and productiveness are its good points.

WHAT VARIETIES TO PLANT.

It is very difficult to give a list of varieties that will be equally suitable for all localities. Differences in soil, climate and manner of cultivation should be taken into consideration, also the purpose for which they are grown, whether for market or home use. For market purposes, *Crescent*, *Captain Jack*, *Wilson* and *Manchester*, have been perhaps the most satisfactory of the old well tested sorts. The foliage of the *Manchester* has been quite subject to rust in many localities; where the plants are thus affected to any great extent, some other kind should be substituted. It is best for those who grow strawberries for market to test a number of the leading sorts in a small way and plant most largely of those best adapted to their locality.

WOODRUFF has been one of the most profitable varieties here, either for home use or market. Among the newer sorts, *Bubach*, *Pearl*, *Haverland*, *Crawford*, *Warfield*, *Jessie*, *Monmouth*, *Ohio*, *Daisy*, *Gandy*, and *Woodhouse*, are prephaps among the most promising, and valuable about in the order named. Many other sorts have some good qualities, but those named above appear to possess a greater combination of good points, and those who grow for market would do well to give them a trial.

CENTRAL EXPERIMENTAL FARM,

DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - CANADA.

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JANUARY, 1890.

CENTRAL EXPERIMENTAL FARM.

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DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - - - CANADA.

BARLEY.

BY WM. SAUNDERS, F.R.S.C., F.L.S., F.C.S.,
Director Dominion Experimental Farms.

The barley crop is one of great importance to the farmers of Canada. The annual product of this cereal for the past seven years in Ontario alone is estimated by Mr. Blue, in his Agricultural Statistics of Ontario, at nearly twenty millions of bushels, while the crop for 1888 is put at over twenty-three million bushels. Statistics from other provinces in the Dominion are not available, but their products would largely augment the figures given. Canadian barley is usually of good quality, and the surplus, not required for home consumption, has heretofore commanded a ready sale, at remunerative prices to maltsters in the United States, and such sales have averaged, during the past eleven years, 9,135,455 bushels annually, yielding an average yearly revenue to Canadian farmers during this period of $6,587,592. The export of barley has materially increased of late years, and as the country becomes more thickly settled and a larger area of land brought under cultivation there will, no doubt, be still larger quantities of this grain to dispose of. During the eleven years referred to, the production of barley in the United States has increased from about 42 million bushels in 1878 to 58 millions in 1889, but the increasing consumption has kept up with the increased supply, and hence the demand for Canadian barley has until recently been maintained.

SUBSTITUTES FOR BARLEY.

The demand for barley for the manufacture of beer in the United States has of late been materially lessened by the use of various substitutes. From official returns published in the United States, it appears that while 2½ bushels of barley were used in the manufacture of a barrel of beer in 1888, only one bushel was used

for the same quantity in 1889, the balance being chiefly made up of corn, rice and glucose. As these ingredients enable the brewer to make his beer at less cost than from barley alone, it is scarcely probable that Canadian barley, however good it may be, will continue to find a market in the United States in such quantities and at such prices as in the past.

MARKET OF GREAT BRITAIN.

It is important then for Canada, that other outlets be provided for the surplus barley, and the only other country which requires more barley than it produces is Great Britain. The average importation of barley into the United Kingdom for the past eleven years has been about 33 million bushels, the imports for 1888 having been over 40 million bushels. A considerable quantity of this is six-rowed barley, but that is used only for grinding and distilling, and commands but a low price ; the grain used for malting for which there is a very large demand is two-rowed barley, and of this there are many varieties, all of which, when of good quality, bring relatively high prices. The quota of barley which Canada has sent to Great Britain for the ten years ending with 1887 average 112,000 bushels. In 1878 it was 524,569 bushels, in 1887 only 5,827 bushels, showing that we have practically lost the small market we had there, and for the reasons that we have not grown the varieties of barley which the English maltster requires, and that our six-rowed barley has commanded a better price in the United States than could be obtained for it in Great Britain.

TWO-ROWED *versus* SIX-ROWED BARLEY.

The British brewer's preference for two-rowed barley is very strong, and the question is sometimes asked whether that preference is founded on the greater intrinsic worth of this sort, or on prejudice arising from long usage. To submit this point to a practical test, a sufficient quantity of the two-rowed malting barley was imported from Great Britain in the early part of 1889 and a like quantity of the best six-rowed barley purchased here. These were sent to a competent Canadian maltster and brewer and both lots made into beer, and from the report received of the results of this comparative test we learn that the two-rowed barley yielded 13 per cent. more of extract than the six-rowed, showing that the preference for this barley is well founded. The covering or husk forms about one-

sixth of the weight in two-rowed barley, and from one-fourth to one-fifth of the six-rowed ; this will account for a part of the difference.

It must ever be borne in mind that on no account should the two-rowed and six-rowed varieties of barley be mixed, for when that is the case the sample is of little value for malting purposes, and for this reason: In the manufacture of malt the barley is first steeped to soften it, and when it has reached the proper condition is spread on the floors of the malt-house to germinate, growth is allowed to advance to a certain stage and then suddenly stopped by rapid drying. The plump kernels of the two-rowed barley take longer to soften and are slower in germinating than the comparatively thin grains of the six-rowed, hence the six-rowed will pass through the different stages in the process and be ready for drying from one to two days sooner than the two-rowed. To leave the six-rowed that length of time on the floor after it is ready for drying would result in decay and the growth of mould which would seriously injure the quality of the malt. For this reason no maltster will have anything to do with mixed barleys.

CAN TWO-ROWED BARLEY BE SUCCESSFULLY GROWN IN CANADA ?

This is a vital question, which demands careful consideration. Since the establishment of the Experimental Farms of the Dominion an extensive series of experiments have been planned and carried out for the purpose of obtaining evidence on this point, and of ascertaining what varieties of two-rowed barley are most suitable and what districts are likely to produce the best samples. These tests have been undertaken on a comparatively large scale by the several Experimental Farms, and in order that the experiments might be made to cover as large an area as possible, sample bags of two-rowed barley of about three pounds each have been distributed among farmers throughout the Dominion for test.

RESULTS OF TESTS ON THE EXPERIMENTAL FARMS.

The cultivation of barley on the Central Experimental Farm has been carried on with many sorts and in several different methods. Experiments with field crops have been conducted to ascertain the relative yield and quality of the several varieties under such conditions, and also with the individual sorts grown under exactly the same circumstances, with the view of testing their relative tendencies to fertility. The fact is too often overlooked that there is in

every variety of grain, and indeed in every kernel of each variety, an inherent impress of vigour and productiveness which favourable conditions will always bring out and which unfavourable conditions cannot entirely suppress. With the view of obtaining light on this very instructive problem the following methods were adopted which have been carried out for the past two years on the Central Farm :

A very uniform piece of land was selected—a sandy loam rather light in character—this had received a coating of barnyard manure in the spring of 1887, which was followed by a crop of spring wheat. The land was ploughed early in the autumn and lightly ploughed and harrowed the following spring. Fifty kernels of each variety of barley were planted in two rows, the grains being placed a foot apart and with two feet of space between each sort. Every seed had thus ample room for development, and when the grain was two or three inches high a uniform top dressing was given to the whole of a mixture of fertilizers in the following proportions per acre—200 lbs. of nitrate of soda, 500 lbs. of bone dust, and 1,000 lbs. of unleached wood ashes. The growing grain was occasionally hoed to keep the ground free from weeds and when ripe the crop of 1888 was harvested as follows :—One of the best examples of each sort was threshed and cleaned separately, the number of heads counted and the yield ascertained ; a second selection of three or four more of the most vigorous plants were similarly treated, and those remaining were harvested together and their average yield obtained. During 1889 the same varieties were planted with such additional sorts as could be got and the whole of the plants in each case harvested and threshed together. In the following table the results of these tests are given, the number of heads on the single selected plant in 1888, also the yield, the average number of grains obtained from the second selection of three or four plants, the number of plants remaining and the average yield of these unselected ones, followed by a column in which the average of the whole is given. The number of single plants of each sort which matured in 1888 is also given and the average yield in each case. A ready means is thus afforded of comparing the fertility of the different varieties, also the results obtained from the same variety for the past two years.

Those sorts for which a record is given for 1889 only were not obtained until the spring of that year.

Two-rowed Malting Barley.	Records for 1888. Single selected plants. No. of heads.	Single selected plants. No. of grains.	Second select'n. Average No. of grains.	Unselected plants. No. of plants.	Unselected plants. Average No. of grains.	Total average.	1889. No. of plants.	1889. Average No. of grains.
1 Annet Scotch	44	778	493	27	314	359	45	628
2 Australian	23	523	366	43	278	290	46	684
3 Bestehorns	42	834	630	39	498	515	40	783
4 Beardless	..	.	..	..	..	..	17	596
5 California	33	680	755	41	537	554	43	549
6 Chevalier (from Germany)	28	498	373	37	325	333	44	546
7 Chevalier, Danish	51	1203	733	40	512	543	45	691
8 Chevalier Danish Printice	36	832	593	40	421	445	43	653
9 Chevalier, Improved, O. & M.	29	581	436	43	300	317	26	430
10 Chevalier, Scholeys	38	799	590	34	419	442	40	568
11 Chevalier, Hallet's Pedigree	61	907	509	41	380	400	43	583
12 Carter's Prize Prolific	..	..	..	..	..	..	45	546
13 Cheyney	29	694	687	34	446	471	40	605
14 Danish (from London Market)	49	997	950	37	623	656	48	613
15 Denmark (from Germany)	29	702	569	39	544	549	46	722
16 Dutch (from Germany)	37	816	719	40	348	384		..
17 English Malting	42	886	412	30	481	487	43	666
18 Emperor	27	633	519	41	440	449	41	624
19 Golden Drop	28	684	694	38	446	469	36	656
20 Golden Melon (from Germany)	36	784	657	33	476	499	38	693
21 Golden Melon, Impr'd O. & M.	33	776	564	39	406	425	37	610
22 Italian	41	962	490	40	452	466	46	684
23 Kalina	17	332	428	40	355	361	43	652
24 Imperial	32	663	428	32	284	306	46	600
25 New Zealand	58	1114	918	33	692	721	46	794
26 Odessa	31	677	..	12	439	457	44	933
27 Peacock	27	746	463	36	476	481	41	543
28 Prolific	48	609	726	33	454	469	44	686
29 Phœnix von Thalen	23	529	436	40	307	322	45	715
30 Peerless White	36	913	777	41	540	564	39	616
31 Screened French	49	1014	672	40	389	422	44	586
32 Swedish	56	943	939	30	590	601	45	644
33 Thanet, Improved	28	749	737	39	508	529	42	707
34 Victoria	43	360	303	31	361	354	43	732
35 White Erfurt	32	686	762	41	426	454	46	686

The dates of sowing and harvesting have also been recorded and the average time required for the two-rowed barleys in 1888 was 86 days, and in 1889 111 days, showing a wide difference in this respect between the two seasons, the former of which was very dry, the latter very wet—probably 95 to 100 days would be about the average of a series of years in the Ottawa district.

All the varieties of two-rowed barley are later in ripening than the six-rowed sorts, the difference varying from five or six to ten or twelve days.

In comparing the average results for 1888 with those for 1889, it will be seen that all the varieties have yielded better during the year, some of them giving double, and in one or two instances nearly three times the crop of the previous year. The season was not very favourable, although perhaps more so for barley than that of 1888. A part of this increase is no doubt due to the fact that the seed from which these late samples were produced was all carefully selected, the kernels large and plump and taken from the grain grown as single plants in 1888, whereas those sown in 1888 were average grains taken without selection from a field crop. Possibly some portion of the increase may also be due to acclimatization, for it is an undoubted fact that barley brought from another, and perhaps dissimilar and distant climate, seldom does so well the first year as it will the second or third season.

Several varieties of two-rowed malting barley were not received in time to be sown with the others, and the kernels were planted a foot apart like the others, but from 10 to 16 days later. The results are instructive as pointing to the advantage of early sowing :—

	No. of plants.	Average No. of grains.
Selected Chevalier O. and M.	37	177
Early Minting	37	141
Peerless White	35	197
Californian Chevalier	29	169
Dutch	37	174
Frobestier	33	142

Field Crops of Two-rowed Barley on the Experimental Farms, 1890.

	Central Exp. Farm.		Exp. Farm, Brandon, Manitoba.		Exp. Farm, Ind. Head, N. W. T.		Exp. Farm, Nappan, N. S.			
	Yield per acre.	Weight per bush.	Yield per acre.	Weight per bush.	Yield per acre.	Weight per bush.	Quantity sown.	Weight of yield.	Weight per bush.	Weight per bus. of seed imported.
	Bus.	Lbs.					Bus.	Lbs.	Lbs	
Beardless....................	50⅛	51¾	..	54½	27¼	55	..	..	..	56
California....................	21¼	49¼	..	..	..	..	..	..	..	..
Carter's Prize Prolific........	31½	50¼	..	54	..	..	4	2622	52½	54½
Chevalier Danish..............	31⅛	50½	27¾	56	12⅔	55	2	748	51½	57
Chevalier, Danish Printice...	36¼	50¼	..	55½	14	53½	2	644	52	..
Chevalier Improved O. & M..	...	..	..	..	26⅔	53	..	..	..	..
Chevalier, Selected O. & M..	31⅛	51	..	...	12	52	3 lbs.	41	52	..
Early Minting.................	25¾	50¾	..	..	13⅔	53½	..	..	..	..
English Malting...............	34¼	50½	27	53	23⅓	53½	..	..	..	54½
Golden Melon Improved......	26	48¾	..	54½	17¾	55	..	..	..	58
New Zealand...................	26½	51	..	55½	23	54	1 bus.	350	52½	..
Peerless White...............	36½	51	...	54¾	18¾	52	3 lbs.	40	52	..
Swedish........................	49	50¼	..	55	24½	55¼	..	..	..	..
Thanet Improved............	44	48½	..	55	21⅓	52¼	..	..	..	..
Saale...........................	22	51	..	..	19½	53	6 lbs.	74	51½	55½

Ten varieties were grown in field plots on the Experimental Farm at Brandon, but the yield per acre is given of two only for the reason that these were sown on summer fallow, the others on wheat stubble, and under such different conditions any comparsion as to yield in a dry season would be misleading and throw discredit on varieties which would have made a good record on summer fallow. In these instances the weight per bushel only are given. The yield on wheat stubble varied from 14 to 6¼ bushels per acre.

The Superintendent of the Indian Head Farm, when submitting his report, says :—Thanet and Danish Chevalier were greatly injured by winds. The small yield and light weight of Saale, Early Minting, Selected Chevalier and Peerless White is, no doubt, owing

to their having been sown so late. The seed was very fine, and had they been got in early would have made much better returns."

The samples of the crops received from Brandon and Indian Head are very bright and handsome, those from Nappan, N. S., and those grown at Ottawa are good samples, but more or less discoloured.

The Carter's Prize Cluster and Saale barleys were obtained from James Carter & Co., London, England; Beardless, Improved Chevalier, Selected Chevalier, Early Minting, Improved Golden Melon, Peerless White and Improved Thanet, from Oakshott & Millard, Reading, England; Danish Chevalier and Danish Printice Chevalier, through the courtesy of the President of the Danish Royal Agricultural Society at Copenhagen: Danish, English Maltting, New Zealand and Swedish from Harris & Co., London, England, and the other varieties from Haage & Schmidt of Erfurt, Germany. All the samples of seed imported were unusually fine and weighed from 54 to 57 pounds ber bushel.

RESULTS OF BARLEY DISTRIBUTION.

We shall next consider the results obtained by farmers in different parts of the Dominion from the samples of two-rowed malting barley, which were distributed for test. 946 sample bags were sent out containing from 2¾ lbs. to 3 lbs. each. Some of the farmers have reported promptly, but a large number of the reports are yet to come in. The following are taken from among the more favorable results:

Carter's Prize Prolific.

This variety, judging from thirty reports received, has succeeded remarkably well. In Ontario, Henry Jennings, of Victoria Square, got 176 lbs. weighing 53 lbs. per bushel; Henry R. Wilson Winona, 147 lbs., which weighed 55¼ lbs. ber bushel; Duncan McDonald, of Glen Robertson, Glengarry, had 120 lbs., weighing 52½ lbs. to the bushel, and Colin Philips, of Brougham, got 110 lbs. which weighed 54 lbs. per bushel.

In Quebec, Duncan Stewart, of Inverness, had 60 lbs., which weighed 53¼ lbs. per bushel, and Joseph Guérin, of St. Gabriel de Montréal, 45 lbs., weighing 51½ lbs. per bushel.

In New Brunswick, W. T. Hall, of Georgetown, had 47 lbs., weighing 48½ lbs. per bushel, other samples sent from this Province weighed 53½ and 50½ lbs. per bushel, but the yield is not given. No reports on this barley are yet in from Nova Scotia. In Prince Edward Island, Benjamin Cole, of Centreville, got 95 lbs., an extra good sample which weighed 50 lbs. to the bushel.

In Manitoba, McKee Bros, of Heaslip, had a yield of from 80 to 90 lbs., weighing 51 lbs. to the bushel, and Duncan McCuaig, of Portage la Prairie, 68 lbs., which weighed 52⅔ lbs. per bushel. Major Boulton, of Shellmouth, sends a sample which weighs 52 lbs. to the bushel, but was unable to give the exact yield.

From Moose Jaw, N. W. T., Mr. John Smail had a yield of 100 lbs., which weighed 53 lbs. per bushel, and from British Columbia comes a report of the largest yield yet recorded, Mr. S. A. Agassiz, of Agassiz, had a crop of 365 lbs. from 2½ lbs. of seed.

Danish Chevalier.

This variety also promises well. From Ontario samples have been received from George Fisher, of Freeman, who harvested 125 lbs. from 2 lbs. 13 ozs. of seed, weighing 54¼ lbs. per bushel; Daniel Baxter, of Belmont, had 115 lbs.; J. J. Coyne, Chesterville, 96 lbs., which weighed 48 lbs. to the bushel; A. W. Peart, of Freeman, 94 lbs, whighing 53 lbs. per bushel, and Thomas Manderson, of Myrtle, 75 lbs., weighing 53 lbs. per bushel.

From Quebec, John Murphy, of Dalling, reports a yield of 45 lbs., weight 48 lbs. per bushel.

In New Brunswick, James Kerr, of Summer Hill, Queen's Co., had 130 lbs., weighing 47½ lbs. to the bushel, and from Prince Edward Island, Fred R. Mellish, Union Road, Montague Bridge, reports a yield of 42 lbs., weighing 49½ lbs. per bushel. From the North-West Territories a very bright and handsome sample was sent by J. L. Hawk, of Medicine Hat, who harvested 57 lbs., weighing 56⅛ lbs. per bushel. Reports from other Provinces have not yet been received.

Danish Printice Chevalier.

Very few reports have yet been received of the tests of this variety. In Ontario, Thomas Manderson, of Myrtle, had a crop of

83 lbs., weighing 53 lbs. to the bushel ; J. Baxter, of Pickering, 48 lbs., which weighed 52 lbs. per bushel, and John A. Bruce & Co., of Hamilton, 42 lbs., weighing 52 lbs. per bushel.

From Nova Scotia, C. Newcomb, of Weymouth, reports a yield of 122 lbs. The other Provinces have not yet been heard from.

English Malting.

Of this variety the following reports are from Ontario : A. W. Brown, of Rebecca, had 130 lbs. from $2\frac{3}{4}$ lbs. seed, which weighed $52\frac{1}{4}$ lbs. per bushel ; Mr. McNaughton, of Greenock, Guelph, 102 lbs., weight $53\frac{1}{4}$ lbs. per bushel, Wm. Graham of Peterboro', reports 68 lbs., and Thomas Manderson, of Myrtle, 67 lbs., weighing 54 lbs. per bushel.

In Quebec, Wallace Oliver, of Magog, had 45 lbs., weighing 51 lbs. per bushel. From Nova Scotia, Donald McLennan reports a yield of 3 pecks from $2\frac{3}{4}$ lbs. seed, weighing $52\frac{1}{2}$ lbs. per bushel, and in Prince Edward Island, John McDonald, of St. Peters Lake, had 50 lbs., weighing $54\frac{2}{3}$ lbs. per bushel.

Major Boulton, of Shellmouth, Manitoba, sends a good sample of this barley grown by Denmark and Martin, of Russell, Manitoba, weighing $52\frac{1}{2}$ lbs. per bushel, but is unable to give the yield. From British Columbia, Donald Graham, of Spillamacheen, reports a yield of 174 lbs. from $2\frac{3}{4}$ lbs. of seed, and W. A. Johnson, of Quesnell, 64 lbs., weighing $50\frac{3}{4}$ lbs. per bushel.

Beardless.

Beardless barley is scarcely a correct name for this variety, as it is bearded like other sorts, but often sheds its beard when fully ripe, and in every plot there will be found more or less of wholly or partially naked ears as the time of harvest approaches ; the beard dropping so readily from the grain when mature is a great advantage in threshing and cleaning.

Very few reports have yet been received of the test of this handsome barley and in most of those at hand the yield is not given.

J. Dearness, of Granton, Middlesex, Ont., got 55 lbs. from 3 lbs. of seed. John A. Bruce & Co., of Hamilton Ont., from a like quantity obtained 40 lbs., weighing 54 lbs. to the bushel. The other Provinces are not yet heard from.

The results now submitted of the tests of these five leading varieties of two-rowed malting barley over a very large area in Canada are sufficient to show that even in an unfavourable season for barley-growing there is a wide territory over which two-rowed barley for the English market can be grown with advantage, and the yield obtained from the samples sent out as well as in field culture at the Experimental Farms would indicate that heavier crops of two-rowed barley of the varieties named could be raised than of the ordinary six-rowed barley. It is not practicable to entirely change any important crop in a single season, especially when it covers so large an area ; it is better for many reasons that such a change should come more slowly, but it does seem feasible to bring this about to a very large extent within a comparatively short time.

IMPORTANCE OF PURE SEED OF GOOD QUALITY.

From what has been said as to the absolute necessity of having the two-rowed barley unmixed if it is to command a ready sale, good pure seed is the first necessity. The quantity of pure seed now available at the several Experimental Farms is probably sufficient to give to every farmer who will apply for it a 3 lb. sample. If this quantity is carefully and early sown on a good piece of land, well prepared, the average return is not likely to fall much below two bushels, and with two bushels of pure seed available for the spring of 1891, sufficient to sow an acre or more, every possessor of such barley will probably have from 25 to 40 bushels available for sowing in the spring of 1892, and with a little extra care I am convinced that the yield could be made to exceed this estimate. In this way a practicable solution of the difficulty of supplying Canadian barley growers with good seed of pure two-rowed barley would be had and from that time forward two-rowed barley could be grown in large quantities for the English market. Whether it might not be desirable to hasten this change by the importation of a few thousand bushels of good seed for sale to farmers is a question well worthy of careful consideration. The two-rowed would not be likely to supercede the six-rowed in every locality. A very large quantity of barley is required every year for feed, and the fact that the two-rowed sorts are on an average from a week to ten days later in ripening than the six-rowed, might be an objection to their growth in some places.

The large yearly outlay by the United States maltsters in the purchase of Canadian barley has long been the subject of serious consideration. In 1885-6 the Chemical Division of the Department of Agriculture at Washington undertook the analysis of a large number of samples of barley; of these, 60 were obtained from different parts of the United States and 12 from Canada. The Canadian samples were all from the Province of Ontario and from commercial sources. Mr. Clifford Richardson was intrusted with the work and the results of the analyses were favourable to the Canadian samples. In summing up his conclusions Mr. Richardson says: "it may safely be said that the Canadian grain is the best in the market and superior to our own." After comparing the results of his own work with 127 analyses of European barley he says: "the specimens which have been examined from Canada are well above foreign averages in starchiness. Experience and care have taught the Canadians, in connection with their favourable climate, the means of producing an excellent grain superior to other parts of the country." He further states: "our investigations as a whole seem to prove that, while at present Canadian barleys are superior to those grown in the United States, the result is due more to a lack of understanding of the proper localities and methods of cultivation than in any obstacle in the way of extending the production to an extent to do away with our dependence on importation. Field experiments are now most desirable as a means of deciding upon the best varieties and methods as soon as a study of the climatic conditions shall enable us to select those portions of the country best suited to this cereal."

Since the publication of this report the means for carrying on such experimental work have been liberally supplied by the United States Government, and in every State in the Union Experiment Stations have been established which are subsidised by the Federal Government. In the estimates for the current year $630,000 is appropriated directly to the Experiment Stations to aid them in carrying on their work, and in addition to this, $1,359,000 for the other work carried on by the Agricultural Department, a large sum being devoted to special lines of scientific investigation having a direct bearing on agriculture. In commenting on the necessity for these appropriations, the Secretary of Agriculture, in his report for 1889, says the "amount should not be measured by the past, but rather by

what a great agricultural country should pay at this time towards sustaining, protecting and promoting a calling which lies at the foundation of its prosperity and power."

The stimulus which this activity and large expenditure is giving to agriculture among our neighbors will, no doubt, result in improved methods in farming, and increased returns to the nation, and they are mentioned in this connection mainly for the purpose of impressing upon Canadian farmers the fact, that apart from the question of the use of substitutes for barley—which is probably the main cause of the present depressed condition of the barley market—it is not likely that the United States will long continue to be so largely dependent on Canada for good barley. Hence it is important that our farmers bestir themselves, and by bringing more skill to bear on their work, growing those crops which are best suited to their land and likely to give the best returns, and carefully selecting good seed, make the most of the fertile soil and good climate with which they are favoured. It is not to be expected that malting barley of high quality can be grown in every part of Canada ; many districts will, no doubt, be found where it will attain a greater degree of perfection than in others. This has been the experience in Great Britain, where Suffolk, Norfolk and parts of Essex and Herts are held to be specially adapted for barley; similar experience has also been had on the continent of Europe. The only way to ascertain where specially favourable conditions exist, is by testing this grain in every promising locality, noting the results and repeating the tests until sufficient facts are available on which to base conclusions.

TWO-ROWED BARLEY IN DENMARK.

In proof of what may be done to improve the barley crop of a country, the case of Denmark, now a large exporter of malting barley to Great Britain, may be cited. In a recent number of the Journal of the Royal Agricultural Society of England, is a paper on barley from a maltster's point of view, by Robert Free, in which he says : "Only a few years ago the barley production of Denmark was practically confined to a coarse thick-skinned native grain, suitable only for distilling or grinding, and the change is mainly due to the energetic action of the Danish Royal Agricultural Society with the assistance of the Government. In 1883, a committee of the society was formed to ascertain by what means of

cultivation, &c., the best possible quality of barley, yielding the greatest commercial value, might be obtained, and a subvention of £300 per annum was granted by the State to the society for this purpose. The committee accordingly distributed some 800 lots of seed, each consisting of half a hundred-weight of fine Chevalier barley, to farmers in districts where it was found that barley could be profitably grown. The condition was imposed upon every recipient that he should report the results of the experiment, and an annual exhibition of malting barley was established at Copenhagen, where their commercial value was appraised by experts. It has been found that in every case, out of seven or eight kinds of imported seeds, the 'Chevalier' gave the most profitable returns to the farmer, and this has naturally led to its general adoption.

The experiments in cultivation have also had an important influence. Early sowing was found to be most satisfactory, for the spring in Denmark is generally dry, and it is therefore desirable to get the seed into the ground while it retained some of the winter moisture. As to harvesting, it was ascertained that the best time to cut was when the grain was fully matured and the ears began to droop. Useful hints based on the experience gained were also circulated among the growers by the Society as to stacking, threshing and storing, and the practical result of the whole has been to revolutionize this branch of agriculture in Denmark, the annual money outlay, be it observed, amounting to no more than £300. It is now estimated that one-third of the arable land in Denmark is devoted to barley culture, and the total yield is about 2,750,000 quarters."

HINTS ON BARLEY-CULTURE.

The opinion is generally held by farmers in Great Britain that land to be used for barley-growing should be prepared beforehand by manuring some preceding crop, and that the application of barn-yard manure to a crop which remains on the land so short a time as barley does is not likely to produce satisfactory results. The roots of barley grow rapidly but do not strike deep ; they are comparatively feeble and short lived, and are not adapted to use such fertilizing materials as are not fully prepared to be taken in. On the other hand, it is important not to use such manures as would stimulate growth too rapidly, which would make the crop run to straw rather than to grain. In Germany where large crops of barley are grown it is common to grow two crops in succession,

after a crop of sugar beets, for which the land is heavily manured. Few crops respond more readily to generous and judicious feeding than barley, or languish more decidedly where food is wanting. In England, when the land is otherwise in good order, barley is usually dressed with such artificial fertilizers as are readily soluble, such as two or three hundred pounds of superphosphate, with from 50 to 100 lbs. of nitrate of soda per acre, applied before seeding.

A moist soil is necessary to start the plants promptly: when too dry germination is apt to be long delayed. One of the chief reasons why sandy soil is not found suitable for barley is that such soil is not capable of holding moisture to the same extent as a loamy soil. Experiments conducted in Germany have demonstrated that a rich loamy soil a foot deep will hold and retain more than double the quantity of water which a light sandy soil can retain. Hence, having twice as much water at the start, supplemented by summer showers, loamy soil is placed at an immense advantage over sandy soil, apart from the question of nutriment. This also is one of the chief reasons why sandy soil, no matter how heavily manured, rarely gives crops as good as can be obtained with less fertilizing from good deep loams.

On the other hand, a wet soil is detrimental, and land for barley-growing should be well drained. A light, rich, friable loam is generally regarded as the most suitable soil for barley, although it does well on a clay loam if thoroughly worked until it is reduced to a fine mellow condition. A well pulverized and clean seed bed is all-important. Barley is said to do best in a warm, dry atmosphere with occasional light showers; a free circulation of air and plenty of light are also essential conditions to success. The questions of admission of light and circulation of air have an important bearing on thick seeding; the width between the rows and the direction in which the rows should run also require further and frequent tests. Weeds probably do more harm to such crops by the exclusion of light and air than from what they take in the way of nourishment from the soil. Early sowing is also much favoured, sowing as soon as the ground is dry enough to be well pulverized. This is said to counteract the tendency to over-luxuriance, which sometimes injures the crop in rich soils. When drilled, two bushels of seed to the acre is commonly used; some farmers use less, but a full allowance of seed prevents excessive tillering and consequent irregular and later ripening.

The selection of good, plump seed cannot be too strongly urged, as so much depends on giving the plants a good start at the outset. Experiments have shown that selected, extra heavy seed, has produced nearly three times the weight of actual growth in the first fifteen days after sowing than was obtained from light seed. It is important, especially in districts liable to drought, that this vantage point of growth in the beginning should not be overlooked. From the time when the blade appears above ground to the time of the appearance of the ear the plant is most active in gathering and storing in its stems, leaves and roots food for the maturing of the grain, and during the growth of the grain a transfer takes place of a large part of these stores of food from the leaves and roots to the seed ; hence it may be said that a crop of barley is comparatively safe as to food supply when the plants have reached in full vigour that stage in their growth when seeds have begun to form in the ears.

"Barley for malting," says an eminent English maltster, "should be allowed to ripen thoroughly before harvesting, for thus only can a really mellow grain be secured. When cut too early the grain becomes steely, and hence of far less value to the maltster." Some Canadian growers advocate cutting early so as to secure a brighter barley, but this is a mistake. It is better to run the risk of a little discoloration—for this does not materially injure barley for malting—than to cut it before it matures. In threshing, great care should be exercised to avoid breaking the grains, as broken kernels reduce the value of the grain, are worthless for germinating and injurious to the malt. After threshing, and when put into bins or heaps on the barn floor, the heaps should at first be turned over every few days, otherwise the moisture in the grain may result in its acquiring an earthy flavour, which will greatly injure it. Before being marketed the grain should be thoroughly cleaned and put through the fanning-mill often enough to blow out and separate all the light and broken grains ; and all admixture with foreign seeds should be carefully avoided ; a good, plump, clean sample commands a higher price, and a readier sale, and the light grain separated can be profitably used as feed.

It is believed that two-rowed barley will produce on an average as many measured bushels as six-rowed. Taking the market reports in the "Mark Lane Express" of London, for the five weeks end-

ing January 6th, we find that malting barley from Austria has ranged in price from 34 to 38 shillings per quarter of 448 lbs., from California 35 to 40, while the Saale barley has commanded from 40 to 44 shillings. Taking as the basis for an estimate the barley from Austria, the English shilling at 25 cents and allowing 20 cents per bushel to cover expenses of transport from Toronto or Montreal to Liverpool or London, this would leave for the grower here from 86 to 98 cents per bushel of 56 lbs. With such possibilities in view and the pressing necessity of securing other and more permanent outlets for at least a portion of the surplus barley of this country, this subject is one which should command careful consideration and united effort.

SIX-ROWED BARLEY.

The six-rowed barleys are often spoken of as four-rowed; there are, it is said, varieties of four-rowed barley in cultivation, particularly in Scotland, but none of these have yet come under my observation. Among the varieties of six-rowed barley, differences as to relative fertility and vigour are found similar to those among the two-rowed sorts. The following have been grown as single plants, treated in exactly the same manner as the two-rowed barleys and with the results given in the table :—

	Records for 1888.						1889.	
	Single selected plant.		Second select'n.	Unselected plants.				
	No. of heads.	No. of grains.	Average No. of grains.	No. of plants.	Average No. of grains.	Total average.	No. of plants.	Average No. of grains.
Baxter's New Six-rowed	..	..	..	..	..	..	38	841
Bombay Karachi	21	514	483	38	361	378	38	678
From Assiniboine Reserve N. W. T. (Grown by Indian named Rabbit Skin.)	21	1197	729	36	421	471	28	945
Greek Six-rowed	15	600	713	41	196	250	38	852
Imperial Improved American	48	1892	1365	33	806	881	39	1233
Mensury	13	613	601	36	640	636	44	1201
Oderbruch	16	762	629	36	579	589	41	809
Odessa Six-rowed	16	687	727	25	690	695	45	826
Petschora	24	825	545	28	448	472	42	1033
Polar	15	789	414	33	332	353	39	916
Rennie's Improved Six-rowed	17	980	895	36	572	614	41	921
Smyrna	22	740	690	41	203	238	41	933
Spring	16	1075	839	28	636	675	41	1034

Baxter's new six-rowed barley is a promising sort, which originated with Mr. J. Baxter, of Pickering, Ontario, and was received for test in the spring of 1889. At that time Mr. Baxter wrote as follows: "I have a small quantity of a new barley (or improved) six-rowed; it is a short, thick kernel, weighs 56 pounds to the bushel, about ten days earlier than our common six-rowed, good straw. This barley originated with me four years ago, from one grain; with three years sowing I have 1½ bushels." Mr. Baxter was requested to send a small quantity for trial, which he kindly did. The sample was very plump in berry, and shorter than usual, but there was not enough of it to test the weight per bushel. The yield of the single plants given above shows this to be a fertile variety; the grain is shorter and more rounded than any of the other sorts, and from a small plot in the field a crop was grown equal to 36¼ bushels per acre. The grain grown was not as plump as the seed sown, and weighed 48 lbs. to the bushel; and a further sample from Mr. Baxter's own crop of this year weighs 50 lbs. per bushel. The claim made for earliness is not thus far fully borne out in our experience, as will be seen from the following:—

	Sown.		Harvested.		Time of Maturing.
Baxter's New Six-rowed......	May	6	August	5	91 days.
Bombay Karachi..........	"	4	"	4	92 "
From Assiniboine Reserve...	"	9	"	7	90 "
Greek Six-rowed...........	"	4	"	5	93 "
Imperial Improved American.	"	6	"	10	96 "
Mensury.................	"	4	"	5	93 "
Odessa Six-rowed.........	"	6	"	5	91 "
Petschora................	"	9	"	1	84 "
Polar....................	"	9	"	1	84 "
Rennie's Improved Six-rowed	"	4	"	1	89 "
Smyrna..................	"	6	"	4	90 "
Spring..................	"	6	"	5	91 "

Petschora and Polar were both one week earlier than Baxter's barley, but the grain is not nearly as plump. These two barleys (which are probably identical) have, however, improved since they were imported two years ago, as will be seen by reference to the results both from single plants and field crops. The Petschora was brought from the neighbourhood of the Petschora River, in the northern part of Russia, and the Polar from latitude 67, in the

same country, north of Archangel and within the Polar circle. The locality where this barley was grown is said to be the extreme northern limit for the cultivation of cereals in Europe. From many careful comparisons made at different periods in their growth, I am of opinion, notwithstanding the difference in yield of single plants, that the barleys known under these two different names are identically the same.

Results of Field Crops.

	Central Experimental Farm. Yield per Acre.	Central Experimental Farm. Weight per Bushel.
Baxter's New Six-rowed........	36¼	47⅓
Bombay Karachi..............	29⅓	36½
From Assiniboine Reserve......	45	46
Greek Six-rowed..............	53	44⅔
Imperial Improved American...	43	40¼
Mensury....................	21¾	46¼
Oderbruch..................	26½	44
Odessa Six-rowed............	61	45⅔
Petschora..................	30	43½
Polar......................	34¾	44¼
Rennie's Improved Six-rowed...	45½	45¼
Smyrna.....................	..	46½
Spring.....................	45¼	44¼

The Mensury barley was sown on a piece of rather low land, which was quite dry in 1888, and hence not then underdrained; but 1889 being a very wet season, this plot was seriously injured by water, and hence the yield must not be taken as a fair criterion of what returns Mensury barley would give under favourable conditions. This barley, which weighed 46¼ lbs. per bushel at Ottawa, weighed 48 lbs. at Nappan, N. S., 52¼ lbs. at Brandon, 51 lbs. at Indian Head. Petschora weighed at Ottawa 43½, at Nappan 48½ lbs., at Brannon 49½ lbs., and at Indian Head 51½ lbs. Polar, which weighed 44¼ lbs. at Ottawa, weighed 45 lbs. at Nappan and 49½ lbs. at Brandon.

BARLEYS FOR FEED.

Reference will next be made to the results of tests of a few varieties of barley which are grown exclusively for feeding, all of which—with the exception of the Earliest Two-rowed Black—are

hulless; that is, they thresh out like wheat, clean from hull, and they cannot be used for malting. Most of them are very prolific, and where feeding barleys are required are well worthy of more extended trial than they have hitherto had. The first two on the list are two-rowed, the others are six-rowed.

	Records for 1888.						1889.	
	Single selected plant.		Second select'n.	Unselected plants.		Total		
	No. of heads.	No. of grains.	Average No. of grains.	No. of plants.	Average No. of grains.	average.	No. of plants.	Average No. of grains.
Earliest Two-rowed Black......	44	747	845	32	439	482	44	571
Large Two-rowed Naked........	27	476	326	27	266	281	46	557
Guymalaye....................	16	819	562	38	418	441	44	1528
Small Blue Naked..............	27	1326	613	36	577	599	44	1362
Naked from Nepal..............	13	322	280	31	157	172	28	1175
Hulless Black..................	12	540	596	36	298	333	39	689
Six-rowed Wheat Barley........	33	1705	1131	36	744	806	39	1713

These barleys are all very heavy. The large Two-rowed Naked from single plants weighs $61\frac{1}{4}$ lbs. per bushel, and from a field crop which gave $25\frac{1}{2}$ bushels per acre the weight was $54\frac{3}{4}$ lbs., time from sowing to harvesting, 90 days. Guymalaye weighed $57\frac{1}{2}$ lbs., time 89 days; Small Blue Naked $55\frac{2}{3}$ lbs., time 89 days; Naked from Nepal, $58\frac{1}{4}$ lbs., time 90 days; Hulless Black, $60\frac{1}{3}$ lbs., time 90 days; Six-rowed Wheat Barley, 55 lbs., time 89 days, and Earliest Two-rowed Black, 44 lbs., time 91 days. Perhaps a better idea can be given of the prolific character of these hulless sorts by giving the weight of yield in each case. From 46 kernels of Large Two-rowed Naked 3 lbs. $13\frac{1}{4}$ oz. was harvested; from 44 kernels of Guymalaye 4 lbs. 8 oz.; from 44 kernels of Small Blue Naked 3 lbs. $9\frac{1}{4}$ oz.; from 28 kernels of Naked from Nepal, 2 lbs. $6\frac{1}{4}$ oz., from 38 kernels of Hulless Black, 2 lbs. $9\frac{3}{4}$ oz.; and from 39 kernels of Six-rowed Wheat Barley, 4 lbs. 1 oz.

BARLEYS FROM INDIA.

Among the samples of cereals, &c., which were sent last year by the Government of India for test at the Experimental Farms in Canada, there were a number of varieties of barley selected from crops grown at different altitudes in the Himalayas, varying from 450 to 11,000 feet. Judging from the test of a single season, the following are the most promising. The grain is light in weight in most

instances, excepting the hulless sorts, which are very heavy. It is probable that all of them will do better another year, as by that time they will be somewhat acclimatized. All the varieties are six-rowed.

Barley from Palampur, Grown at an Altitude of 3,000 feet.

This barley is much like the common six-rowed of this country, and resembles the Bombay Karachi barley, grown from seed imported from the Corn Exchange, London, England. When received, the Palampur barley weighed $47\frac{3}{4}$ lbs. per bushel; it was sown on the 19th of April and harvested on the 3rd of August time, 107 days; it ripened on the Experimental Farm at Indian Head in 90 days. Grown as single plants, one foot apart, 35 plants gave an average yield of 935 fold; weight 45 lbs. per bushel. This barley grown at Brandon weighed 51 lbs., and at Indian Head $51\frac{1}{2}$ lbs. per bushel.

Barley from high elevation in the Simla District (Elevation not given.)

This proved to be a mixed barley of two distinct sorts, both six-rowed, weighing $48\frac{1}{2}$ lbs. per bushel. In No. 1 the ear is short, about 2 inches only, set very thickly with grain; No. 2 is about $3\frac{1}{2}$ inches long and less compact. Grown as single plants, No. 1 gave an average of 636 fold from 21 plants, and No. 2 of 787 fold from 16 plants. Weight of No. 1, 45 lbs. per bushel; No. 2, $43\frac{1}{2}$ lbs., yield of mixed sorts in field culture, $36\frac{3}{4}$ bushels per acre. Both were sown on the 19th of April and harvested 1st August, time, 105 days. At Indian Head this barley ripened in 90 days, and weighed 49 lbs. per bushel.

Barley from Seoraj, Altitude 7,000 feet.

This barley, which weighed $47\frac{1}{2}$ lbs. per bushel, was also mixed. A part of it seemed to be a variety of winter barley, which made a strong bushy growth of leaf but did not head out at all. Grown as single plants, the average yield from twelve plants which ripened was 646 fold; sown 19th April, ripened August 4th, time 108 days, weight per bushel, $44\frac{2}{3}$ lbs. At Brandon this weighed $49\frac{2}{3}$ lbs., and at Indian Head, where it ripened in 90 days, 52 lbs. per bushel.

Barley from the Kulu District, Altitude 7,000 feet.

This variety weighed 44¼ lbs. per bushel; it made vigorous growth of leaves, but the ears were produced unevenly at intervals. Grown as single plants, the average yield from 36 plants was 782 fold. This sort lodged badly, ripened late and weighed 39 lbs. per bushel; sown 19th April, ripened 12th August, time, 116 days. At Indian Head this barley ripened in 90 days and weighed 51 lbs. per bushel, and at Brandon 50½ lbs.

Barley from the Kangra Valley, Altitude 3,000 feet. Weighed 48⅜ lbs. per bushel.

Not a vigorous grower. In plots of single plants it produced an average of 617 fold from 44 plants, the grain weighing 47¼ lbs. per bushel; sown 19th April, ripened 1st August, time, 105 days. At Indian Head this barley ripened in 90 days and weighed 53½ lbs. per bushel; at Brandon in 101 days.

Barley of Lahoul, Altitude 11,000 feet.

This is a hulless barley which weighed 58½ lbs. per bushel, short plump kernels, some of them of a peculiar bluish colour. Grown as single plants the average yield from 34 plants was 553 fold, grain weighing 56 lbs. per bushel. The growth was vigorous, but it ripened late; sown 19th April, ripe 22nd August, time, 126 days. At Indian Head this ripened in 106 days, and weighed 64 lbs. to the bushel. At Brandon it ripened in 107 days.

Barley of the Spiti Valley, Altitude 11,000 feet.

This was also a hulless barley, of a faint steely blue colour, which weighed 58 lbs. to the bushel. Both these barleys are very different in appearance from any other varieties hitherto tested at the Experimental Farms. This is a short, plump grain, which ripens earlier than that from the same elevation in Lahoul. At Ottawa it was sown 19th April, ripe 2nd August, time, 106 days, weight, 57½ lbs. per bushel. Grown as single plants the average yield from 24 plants was 351 fold. The growth was not vigorous but the heads were comparatively large, 3 to 3½ inches long. At Indian Head this barley ripened in 90 days and weighed 62 lbs. per bushel; at Brandon it ripened in 101 days.

Several other sorts made a promising growth, but were received too late to give them a fair chance in comparison with the other varieties.

The importance of this subject can only be fairly seen when the magnitude of the interests involved are considered. The total barley crop of the Dominion is probably about 30,000,000 bushels, with an average yield of from 20 to 25 bushels per acre. While this is much larger than is produced in some countries, it falls below the average in Great Britain. Recent returns give the yield of barley in England, Scotland and Wales, for the year 1889, as 31·58 bushels per acre; in 1888 it was 33·14, showing a falling off last year of 1·56 bushels. The results of the tests given in this Bulletin show that there are great differences in the fertility of different varieties, and it is well known that favourable conditions of soil are essential to a vigorous growth. With fertile strains of vigorous seed and skilful and judicious management in the preparation of the soil there seems to be no good reason wh, the farmers of Canada should not be able to work their crops nearly, if not quite, up to the English standard. Such a result is worth striving for; every bushel added to the acre would amount to $480,000 annually to the profits of the farmers, and taking the crop at 30,000,000 bushels, the yield at 25 bushels to the acre and the price 40 cents per bushel, the increase of one pound in weight to the bushel would result in an annual gain of $250,000. With depending issues so great as this, no effort should be spared to place within reach of Canadian farmers the very best strains of seed which the world affords, and to disseminate among them all the information which can be gathered, bearing on the conditions essential to success.

CENTRAL EXPERIMENTAL FARM,

DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - CANADA.

BULLETIN No. 7.

TWO-ROWED BARLEY.

APRIL, 1890.

CENTRAL EXPERIMENTAL FARM.

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DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - - - CANADA.

CAN GOOD TWO-ROWED BARLEY BE GROWN IN CANADA?

Recent opinions of Maltsters, Brewers and Corn Brokers in Great Britain on Canadian Two-rowed Barley, the growth of 1889.

TO THE HONOURABLE THE MINISTER OF AGRICULTURE:

SIR,—

In accordance with your instructions samples of Canadian two-rowed barley of the growth of the past season were forwarded on the 24th of January to the office of the High Commissioner in London, with the request that the opinions of some of the leading maltsters, brewers and dealers be obtained as to their quality and that the endeavour be made to ascertain the prices which such barleys would command at present in the markets of Great Britain. The samples sent were taken from crops grown on the Experimental Farms and from specimens which have been returned by farmers in the several Provinces of the Dominion to whom sample bags were mailed last year for test. Without multiplying the samples unduly, the endeavour was made to have most of the Provinces represented, so that it might be ascertained over how large an area it was probable that two-rowed barley might be grown with profit. The varieties forwarded were of the following five sorts, which formed the bulk of the distribution made last year:

Carter's Prize Prolific Barley.

	Weight per bushel.
From Experimental Farm, Brandon, Man	54
" Winona, Ont., grown by Henry R. Wilson	55¼
" Centreville, P.E.I. " Benjamin Cole	56
Danish Chevalier.	
" Freeman, Ont., grown by George Fisher	54¼
" Experimental Farm, Brandon, Man	56
" " " Indian Head, N.W.T	55
" Medicine Hat, N.W.T., grown by J. L. Hawk	56⅛
Danish Printice Chevalier.	
" Myrtle, Ont., grown by Thos. Manderson	53
" Experimental Farm, Brandon, Man	55½
" " " Indian Head, N.W.T	53½
Beardless.	
" Central Experimental Farm, Ottawa	51¾
" Hamilton, Ont., grown by J. A. Bruce	54
" Experimental Farm, Brandon, Man	54½
" " " Indian Head, N.W.T	55
English Malting.	
" Myrtle, Ont., grown by Thos. Manderson	54
" Experimental Farm, Brandon, Man	54
" " " Indian Head, N.W.T	53½

From the office of the High Commissioner, the following reports and letters have been received. The samples of barley were not large enough to admit of being divided so that each firm might receive some of the same lot, hence the reports are not uniform as to the samples examined :—

"79 MARK LANE, LONDON,
12th February, 1890.

J. G. COLMER, ESQ.,
Secretary of the High Commissioner of Canada,
9 Victoria Chambers,

DEAR SIR,

We are in receipt of your communication of the 11th instant, with three samples of Barley grown in Canada.

They are all fit for malting purposes, but would not be considered *fine* quality in comparison with *fine* English and some foreign produce, such as Moravian, Bohemian and Californian. We imagine

the climate of Canada is not favourable to producing *mellow* Barley, which requires *sun heat* and genial atmosphere.

Carter's Prolific is well liked, having been raised by that firm from *selections* of the *finest* produce and *carefully grown.*

We remain,

Your obedient servants,

M. F. WOODLEY & Co."

In the letter of Sir Charles Tupper to the Minister of Agriculture, which accompanies this, he says : "Messrs. Woodley informs me that the two better samples (those from Winona and Prince Edward Island) would have fetched from 38s. to 40s. a quarter of 448 lbs. in the London market, while that from Brandon would probably have fetched about 36s. Messrs. Woodley wished me to impress upon you the absolute necessity of recommending farmers not to thresh the grain too closely, as they seem to be doing. It may make the grain look prettier, but it chips off the ends, and it has therefore a tendency to go mouldy in malting, which considerably lessens its value."

MEMORANDUM.

"From R. & J. ARDLEY, 60 Mark Lane,

London, Feb. 19, 1890.

To MR. J. G. COLMER :

We have affixed quotations to the four samples of barley received from you this morning. We consider that the prices are about their value on the London Corn Exchange.

1. Beardless Barley—
   From Brandon, Manitoba.................. 38s. per qr.
2. Danish Chevalier—
   From Medicine Hat, N.W.T............... 42s. "
3. Danish Printice Chevalier—
   Indian Head, N. W. T..................... 34s. "
4. English Malting—
   From Brandon, Man........................ 30s. "

From

"IND, COOPE & Co. (Limited),

Burton-on-Trent, March 18, 1890.

J. G. COLMER, ESQ.,

9 Victoria Chambers, London,

DEAR SIR,—

Referring to yours of the 15th ultimo, addressed to our Ramford

house, we beg to say we have carefully tested the samples of barley and find they are quite suitable for malting purposes, and we should estimate their value at from 34s. to 36s. per quarter.

Yours truly,
for Ind, Coope & Co. (Limited),
E. I. Bud, Director."

(No information has yet been received as to the particular samples submitted to either of the firms in Burton).

From

"Mackeson & Co.,
Brewers, Maltsters and Spirit Merchants,
Brewery, Hythe, Kent– Established 1669—
February 28, 1889.

J. G. Colmer, Esq.,

Dear Sir,—

We must apologise for the delay in replying to your favour of the 18th February. We must congratulate you on the improvement in the samples since you last favoured us. We consider there is a great improvement in the size of the barleys, and that they will have very good malting qualities. It is of course difficult without having worked the barley to say what its value is and say what sort of malt it will make. There is one point which we would draw your attention to, that is, that the barley appears to have been carelessly threshed. This particularly refers to the two samples of Danish Chevalier. If you look at these two samples you will find a number of corns cut in half, this is done by the machines being set too closely during the threshing operation. No ordinary cleaning machine will take this out as their diameter is as big as a whole corn.

The presence of these half corns is very detrimental for malting purposes, as they almost invariably mould on the floors, and the mould spores communicate themselves to other corns which likewise become affected with the mould.

We would, therefore, strongly recommend you to advise your farmers to be more careful in threshing. We are inclined to think that the Danish Chevalier barleys are the best. We do not like Beardless Barley for malting, and the 'English Malting' does not appear to us to be quite so mellow as the two samples of Danish Chevalier. We have no doubt that these barleys would find a ready

sale in England, and from the excellent condition in which they are, will stand the voyage without the slightest detriment.

The curse of the barley which comes from the East is the weevil in them. We conclude that in a climate like Canada you will not have this difficulty to contend with.

We notice you ask for the present market value of these samples. As we have before stated it is a difficult matter to assess their value without having tried them, but we should think that the Danish Printice Chevalier would be worth about 37s. to 40s. per quarter in London. English Malting about 34s. to 36s., Danish Chevalier about 36s. ; Beardless about 36s. Any further information we can give you at any time, we shall only be too glad to afford, and if there are any consignments of these barleys coming to England we shall be happy to try them.

Yours faithfully,

Mackeson & Co.

P.S.—It must not be forgotten that barley is abnormally dear this season, in considering these prices."

Through Mr. John Dyke, Emigration Agent of the Canadian Government at Liverpool, the opinion of H. C. Woodward has been obtained. Mr. Woodward is a large buyer and is said to be one of the best judges of grain in England :

"Cereal Court, Brunswick St.,
Liverpool, Feb. 13, 1890.

John Dyke, Esq.,
Agent Canadian Government,
Liverpool.

Dear Sir,—

I am favoured with the letter of the Secretary of the High Commissioner of Canada, addressed to you, and have much pleasure in replying to the questions contained therein. I have also received the three samples of barley grown from Carter's Prize English Seed and am glad to see that the suggestion made in my letter of March 16, 1889, as to experimenting with such in Canada, has been followed out with fairly satisfactory results.

The samples you send and ask my opinion of prove the importance of good heavy seed as they show an *immense stride* in quality as compared with the Canadian growth you submitted last year. I should place as best of these and call No. 1 the parcel grown by H. R. Wilson, Winona, Ontario. This is nice mellow

bright barley, of very good malting quality, and would have fetched 40s. per 448 lbs. in English markets this autumn. No. 2, or second best, is that grown by Benjamin Cole, Prince Edward Island. It is fully as heavy as the first lot, but rather darker in colour and coarser in skin, and I should value at about 38s. per quarter in England.

No. 3, grown at Experimental Farm (Brandon), is disappointing in size and stoutness. It *looks* as though it had been grown on very light sandy land, and been rather 'burnt up' in a droughty summer. The colour is bright, but the grain looks rather harsh and 'steely' and is uneven in size. In fact this sample does not show the advantage of the seed so much as do the other two.

In all three samples there is a certain amount of *broken corn*, due in part to the drum of the threshing machine being set a little too close. Broken corn is *disliked* by maltsters, as it goes to *mould* on the malting floor and affects *flavor* of malt and ale.

In conclusion I have no hesitation in saying that if such samples as No. 1 and No. 2 could be produced in Canada, they would find a ready market in England at the full values of the day for Malting Barleys.

I am, dear Sir,
Yours truly,
H. C. Woodward."

"Cereal Court, Brunswick St.,
Liverpool, March 5, 1890.

H. C. Woodward, & Co.,
Corn Brokers and Commission Agents.

J. Dyke, Esq.,—

Report and valuation of eight samples of Canadian Barley received from J. Dyke, Esq., Agent of the Government of Canada.

Danish Chevalier grown at Medicine Hat, N. W. T., 40s. to 42s. per qr. of 448 lbs.

Danish Chevalier grown at Brandon, Man., 38s. to 39s. per qr. of 448 lbs.

Danish Printice Chevalier grown at Brandon, Man., 38s. per qr. of 448 lbs.

Beardless grown at Brandon, Man., 38s. per qr. of 448 lbs.

Beardless grown at Hamilton, Ont., 36s. per qr. of 448 lbs.

English Malting grown at Indian Head, 35s. per qr. of 448 lbs.

Danish Chevalier grown at Indian Head, 34s. per qr. of 448 lbs.

Beardless grown at Ottawa, 30s. to 32s. per qr. of 448 lbs.

I value the above in the order named. They are all suitable for malting, and the lowest of them superior to the six-rowed or ordinary Canadian type. This year for three or four *first quality* lots even more might be obtained, but barley has sold relatively high this season, especially the best sorts.

Yours truly,

H. C. WOODWARD."

Through Mr. T. Graham, Emigration Agent at Glasgow, Scotland, the following have been received :—

"PETER RINTOUL, SON & CO.,
46 Gordon Street, Glasgow.

T. GRAHAM, ESQ.,
St. Enock Square.

DEAR SIR,

We have examined the samples of Canadian Barley very carefully along with Hugh Baird & Son, Maltsters, and we enclose copy of their report on each sample with to-day's value per 448 lbs. These samples indicate an ability to produce finer barley than we have ever seen from Canada. We think it will be necessary to import each year seed, if the quality is to be kept up. The climate or the land has the tendency to produce light, thin barley, which might be obviated by sowing new seed each year.

The broken grains in some of the samples are very objectionable, more care in threshing would avoid this. All these samples would command a very ready sale, they are specially adapted for brewers, who would, no doubt, give long prices to get so fine a quality as some of the finer samples. The Messrs. Harvey, who tested the samples by malting, say the result is very satisfactory. The number of lie backs is very small.

Yours truly,

PETER RINTOUL & CO."

Report of valuation by Hugh Baird & Son, Glasgow.

"Danish Chevalier, grown by J. L. Hawk, Medicine Hat, N.W.T., is as fine barley as we have ever seen, and should command the highest price of any barley. Value to-day 40s. per 448 lbs.

Danish Chevalier, grown at Experimental Farm, Brandon, Man. Too many broken grains, very bad fault. The barley is fine, and should be worth 38s. to 38s. 6d.

Danish Chevalier, grown at Experimental Farm, Indian Head, N.W.T., grown by Thomas Manderson, Myrtle, Ontario, value about 36s.

Danish Printice Chevalier, 55 lbs., thinner barley, value about 33s.

Danish Printice Chevalier, grown at Experimental Farm, Indian Head, N.W.T., 53½ lbs., value 30s.

English Malting grown at Experimental Farm, Brandon, Man. Sample also grown at Indian Head, N. W. T., both samples about 33s. The one sample is a little better colour than the other.

Beardless Barley grown at Experimental Farm, Brandon, Man., value 37s., weight 54½ lbs., too many broken grains.

Beardless Barley grown by John A. Bruce, Hamilton, Ont., 54 lbs., value 35s.

Beardless Barley grown at Central Experimental Farm, Ottawa, Ont., 51¾ lbs., value 33 to 34s."

It may be interesting to those who are not familiar with the country between the points named to know that from the farm of Benjamin Cole, on Prince Edward Island, to that of J. L. Hawk at Medicine Hat, in the North-West Territories, the distance is nearly 3,000 miles.

The difference in the relative opinions of these experts as to the prices these barleys would command will be seen by reference to the following table:—

TABULATED ESTIMATE OF VALUES PER QUARTER OF 448 LBS.

	M. F. Woodley & Co., London.	R. & J. Ardley, London.	H. C. Woodward, Liverpool.	Hugh Baird & Son, Glasgow.	Mackeson & Co Hythe, Kent.
CARTER'S PRIZE PROLIFIC BARLEY:					
From Brandon, Manitoba	About 36*s*.	....	....	....	....
" Winona, Ontario	38*s*. to 40s.	....	40*s*.	....	....
" Centreville, P. E. I.	38*s*. to 40*s*.	....	38*s*.	....	....
DANISH CHEVALIER:					
From Freeman, Ontario	....	....	....	....	About 36*s*.
" Brandon, Manitoba	....	....	38*s*. to 39*s*.	38*s*. to 38*s*. 6*d*.	
" Indian Head, N. W. T.	....	....	34*s*.	33	
" Medicine Hat, N. W. T.	....	42*s*.	40*s*. to 42*s*.	40*s*.	
DANISH PRINTICE CHEVALIER:					
From Myrtle, Ontario	....	....	....	36*s*.	37*s*. to 40*s*.
" Brandon, Manitoba	....	....	38*s*.	....	
" Indian Head, N. W. T.	....	34*s*.	....	30*s*.	
BEARDLESS:					
From Ottawa, Ontario	....	....	30*s*. to 32*s*.	33*s*. to 34*s*.	About 36*s*.
" Hamilton, Ontario	....	....	36*s*.	35*s*.	
" Brandon, Manitoba	....	38*s*.	38*s*.	37*s*.	
" Indian Head, N. W. T.	....	....	....	....	
ENGLISH MALTING:					
From Myrtle, Ontario	....	....	....	....	34*s*. to 36*s*.!
" Brandon, Manitoba	....	30*s*.	....	33*s*.	
" Indian Head, N. W. T.	....	....	35*s*.	33*s*.	

These valuations of Canadian two-rowed barley effectually dispose of the objections which have been urged by some that two-rowed barley of such quality as will find favour in the English market cannot be grown in Canada. The opinions which have been obtained are those of some of the largest buyers and consumers of barley in Great Britain. The lowest figure named, 30s. per quarter of 448 lbs., is equal to 78 cents in England for the

Canadian bushel of 48 lbs. Taking the average of all the quotations for all the samples we find the figure to be a little over 36s., which is equal to 94 cents for the Canadian bushel in England, while those who can grow barley which will receive the top price, 40 to 42s., would have their grain sell in Great Britain at from $1.06 to $1.12 per Canadian bushel. From these figures must be taken the cost of transportation and the buyer's commission. A trial shipment of six-rowed barley to England was made by some buyers in Western Ontario in February last, when about 20,000 bushels was forwarded. This was taken from the neighbourhood of Toronto and delivered in Liverpool for 30 cts. per 100 lbs. A second shipment of 18,000 bushels was sent early in March from north of Toronto, which cost 38 cts. per 100 lbs. to deliver in Liverpool. From 18 to 19 cts. per bushel would probably cover the cost of transportation from the producer to the consumer during the winter months, while 12 to 14 cts. would be likely to cover the rates obtainable either to Liverpool or London during the period when navigation is open. Taking the average cost at 15 cts. and allowing 3 cts. additional for commission and incidental expenses, this would leave the farmer on the basis of the lowest of the estimates given 60 cts. here for the Canadian bushel ; taking the average figure, it would be 76 cts., and on the higher estimates 88 to 94 cts.

Placing the exports of Canadian barley at 10 million bushels, every cent per bushel added to the price obtained for it puts $100,000 into the pockets of the farmers, and had the entire crop of surplus barley of 1889 in Canada been two-rowed and sold at the lowest figures which have been given for the poorest of the samples sent to England instead of shipping the crop to the United States at an average of about 45 cts., the gain to the farmers of Canada would have amounted to one million five hundred thousand dollars, and could the average price which has been named have been obtained, the difference would have been over three millions of dollars. With such possibilities in view the wisdom of making a strong effort in that direction can scarcely be questioned by any reasonable mind.

The objection has been made in some quarters that two-rowed barley soon runs out and that the deterioration is so rapid that new seed would have to be imported every year—such statements unless based on experience are of very little value.

The experiments in this direction which have been carried on at

the Experimental Farms all point as far as they go to the opposite conclusion, and instead of deterioration there has been a steady improvement. The opinion of most practical farmers whom I have met or corresponded with, who have grown two-rowed barley is that there is no more tendency to run out with this variety of grain than with any other sort, and that with such change of seed from one soil to another and from one district to another as good farmers everywhere practice, there is little doubt that the quality of the grain could be maintained for many years. In Denmark where two-rowed barley has of late been so successfully grown it has been found that any new variety of barley introduced there has required two or three years to acclimatize it, and that while this process was going on a steady improvement was manifest in the crop, and that when acclimatized it retained its vigour for many years. There is no doubt that with indifferent or poor cultivation the best of seed is likely to give poor results. In England the finest barley is grown on land in a high state of cultivation and that will no doubt be the experience here. In Europe barley is usually sown after roots for which the ground is well manured, it is also a common practice to dress the land just before seeding with a mixture of from 200 to 300 lbs. of super-phospate mixed with 50 to 100 lbs. of nitrate of soda per acre. A light, rich, friable soil is generally regarded as the most suitable for barley, although good crops are usually got on clay loam, if it is well drained and the soil thoroughly worked so as to reduce it to a fine mellow condition. The crop should be got in early, and if the seed is of good quality, one and a half bushels to the acre is sufficient. It should be put in with the drill, and it is believed to be advantageous to have the drills run as nearly as possible north and south as the sun can then get freer access between the rows. The facts presented show that the outlook for the Canadian farmer is encouraging, and with the help of the excellent seed now being provided under your instructions, it is hoped that a large, profitable and permanent trade with Great Britain in two-rowed barley will soon be established.

I have the honour to be,

Your obedient servant,

WM. SAUNDERS.

Director Experimental Farms.

OTTAWA, April 12, 1890.

CENTRAL EXPERIMENTAL FARM,

:o:

DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - CANADA.

:o:

BULLETIN No. 8.

:o:

Results of Early and Late Seeding of Barley, Oats and Spring Wheat.

:o:

JANUARY 1891.

Central Experimental Farm.

———:o:———

DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - - - CANADA.

BULLETIN No. 8.

Results of Early and Late Seeding of Barley, Oats and Spring Wheat.

———:o:———

By Wm. SAUNDERS, Director Experimental Farms.

———:o:———

The experience gained at the Central Experimental Farm during the past season on this subject, points to the great importance of early seeding. So vital a bearing does this appear to have on the profits of agriculture, that the results are deemed of sufficient importance to justify their being brought under the notice of the farmers of the Dominion, in a special bulletin with the least possible delay, so that opportunity might be given for discussing the subject at the winter meetings of Farmers' Institutes and Conventions, Farmers' Clubs and Agricultural Circles, with the hope that farmers will undertake tests for themselves in this particular line of work, so that further experience may be gained under those varying conditions of soil and climate, which obtain in different sections of the several Provinces. It is generally conceded that the farmer who makes a practice of getting his seed into the ground at the earliest opportunity, after the land is in suitable condition to receive it, realizes, as a rule, the best returns, but to

what extent the advantage is on his side, has not heretofore been submitted to careful test in Canada.

EXPERIMENTS UNDERTAKEN.

Thirty-six plots of one-tenth of an acre each, were devoted to a test of the relative advantages of early, medium and late sowing of barley, oats and spring wheat, two varieties of each grain being sown. It was decided to sow one of these ranges of six plots, every week until all were seeded, making altogether six sowings. The varieties of grain chosen were as follows :—Barley, *Prize Prolific*, and *Danish Chevalier* (both two-rowed sorts) ; Oats, *Prize Cluster* and *Early Race Horse* ; Spring Wheat, *Red Fife* and *Ladoga.*

The soil selected was as uniform as could be found ; it was a piece of light sandy loam, which when the Experimental Farm was purchased in 1886, was in sod. A crop of hay was taken off in 1887, and finding that the land was much exhausted, a coating of stable manure, about twenty tons to the acre, was applied to it early in the autumn and shortly after the manure was ploughed under with the sod. In the spring of 1888 it was again ploughed, then harrowed and sown with experimental plots of wheat and oats. It was ploughed again in the autumn, and in the spring of 1889 planted with Indian Corn in drills, which was cut in September for ensilage. Subsequently the land was ploughed again and early in the spring of 1890, it received a uniform dressing of unleached wood ashes about 150 bushels to the acre.

The first twelve of the 36 plots were cultivated with a disc harrow, and six of them harrowed with a common iron harrow, on the 21st of April, 1890, and sown on the 22nd ; the other six plots in this series were harrowed and sown on the 29th. The next twelve plots were similarly cultivated, six of them were harrowed on the 5th of May and were seeded on the 6th, while the other six plots in this range were harrowed and sown on the 13th. The remaining twelve plots were cultivated with the disc harrow and six of them harrowed with the iron harrow, on the 19th and sown on the 20th, the last six plots of the series being well harrowed on the 27th of May immediately before sowing. From these particulars it will be seen that the ground was well stirred before each sowing so as to destroy all young weeds which might have started. By the treatment given, the later plots may be said to have had at the start

some advantage over those earlier seeded as far as weeds were concerned; but before the grain matured the weeds made greater headway on the later sown plots.

At the first sowing the *Race Horse* oats was omitted and a new spring wheat sown in its place, known as *Carter's Cross bred* I or *Anglo-Canadian*. This was done for the reason that these plots afforded the best opportunity at command for making a fair test of this new variety alongside of the *Red Fife* and *Ladoga*, so that their relative earliness and fertility might be compared. Otherwise the experiments were carried out as planned. The following table gives the results :—

	Sown April 22nd. Yield per acre.		Sown April 29th. Yield per acre.		Sown May 6th. Yield per acre.		Sown May 13th. Yield per acre.		Sown May 21st Yield per acre.		Sown May 28th, Yield per acre.	
	Bush.	Lbs.	Bush.	Lbs.	Bush.	Lbs.	Bush.	Lbs.	Bush.	Lbs.	Bush.	Lbs.
BARLEY.												
PRIZE PROLIFIC..	40	30	24	38	16	22	14	03	10	15	11	02
DANISH CHEVALIER	33	26	22	14	19	28	15	10	10	30	9	28
OATS.												
PRIZE CLUSTER.....	37	02	33	23	30	20	27	17	20	10	17	22
EARLY RACE HORSE	—	—	35	05	31	26	28	13	18	18	19	04
SPRING WHEAT.												
RED FIFE..........	11	00	9	00	8	15	4	20	3	00	2	35
LADOGA............	10	45	9	15	8	00	3	55	2	50	2	30
ANGLO-CANADIAN..	5	50										

These experiments were carried on with much care so as to reach results as correct as possible, and while it must be admitted that such tests will need to be repeated many times in order to obtain averages which may neutralize the variations brought about in crops by varying seasons, there is nevertheless such a degree of uniformity in the descending scale, week after week, as to carry with it convincing proof of the heavy losses which are almost sure to occur where late seeding is practised. If the results which have been given can be taken as any guide whatever for the future, this subject deserves the most earnest attention of every farmer. The loss on *Prize Prolific* barley by a delay in sowing of one week is nearly sixteen

bushels per acre, and on *Danish Chevalier* a little more than eleven bushels, while a delay of two weeks shows an average loss in the two experiments of more than half the crop, or about eighteen bushels per acre. In the "Statistics of Crops in Ontario" for 1890 recently published by the Bureau of Industries, the area under barley is estimated at 701,326 acres and should one half the average loss which has been shown to have occurred in the experiments at Ottawa, be taken as the basis for an estimate, it would appear that the farmers of Ontario may lose by a delay of one week in the time of seeding over 2½ millions of dollars on the barley crop alone, and by a delay of two weeks, taking the average results of the two experiments, more than 3¾ millions, estimating the value of barley at 50 cents per bushel.

The loss incurred by similar delay in the crop of spring wheat has proved proportionately less, being about one-sixth of the whole where seeding has been delayed one week, and one-fourth where it has been deferred for two weeks, while a three weeks delay shows a loss of considerably more than one-half. Spring wheat, however, owing to an unfavourable season, has given an unusually light crop, and how far these results might be modified under average conditions, can only be determined by further tests. Reckoning the money value of the loss on a similar basis to that of the barley,—that is one half of the actual loss in the average of the two experiments, taking spring wheat at 90 cents per bushel, we find that a delay of one week in sowing shows a possible shrinkage in the value of the crop of Ontario of $473,879, and a delay of two weeks $744,669.

The oat crop appears to be less influenced by delay in seeding than either barley or spring wheat. In the case of the "*Prize Cluster*" it is a falling off of about three bushels per acre for the first week, but with the delay of two weeks it is a little over six and a half bushels, but the oat crop is so very large that every bushel of loss per acre in Ontario alone, taking oats at 40 cents per bushel, is equal to $752,946.

In the following tables are given some further particulars of the growth of the several varieties which may prove of interest. They include dates of sowing, when up, when headed, dates of ripening, with the number of days which elapsed between dates of sowing and ripening :—

BARLEY.	Sown.	Up.	Headed.	Ripe.	No. of days maturing
Prize Prolific, 1st sowing......	April 22	May 9	July 6	Aug, 4	104
" " 2nd "	" 29	" 14	" 9	" 6	99
" " 3rd "	May 6	" 18	" 14	" 12	98
" " 4th "	" 13	" 22	" 16	" 17	96
" " 5th "	" 20	" 26	" 20	" 21	93
" " 6th "	" 27	June 3	" 25	" 24	89
Danish Chevalier, 1st sowing..	April 22	May 6	" 6	" 4	104
" " 2nd " ..	" 29	" 14	" 9	" 7	98
" " 3rd " ..	May 6	" 18	" 14	" 12	98
" " 4th " ..	" 13	" 22	" 16	" 17	96
" " 5th " ..	" 20	" 26	" 20	" 21	93
" " 6th " ..	" 27	June 2	" 26	" 23	88
OATS.					
Prize Cluster, 1st sowing.......	April 22	May 10	" 4	July 30	99
" " 2nd "	" 29	" 16	" 11	Aug. 8	101
" " 3rd "	May 6	" 20	" 12	" 8	93
" " 4th "	" 13	" 24	" 13	" 11	90
" " 5th "	" 20	" 27	" 16	" 13	85
" " 6th "	" 27	June 3	" 21	" 16	81
Early Race Horse, 1st sowing..	April 29	May 16	" 9	" 8	101
" " 2nd " ..	May 6	" 20	" 13	" 9	94
" " 3rd " ..	" 13	" 24	" 13	" 11	90
" " 4th " ..	" 20	" 27	" 16	" 13	85
" " 5th " ..	" 27	June 3	" 21	" 16	81
WHEAT.					
Red Fife, 1st sowing............	April 22	May 9	July 5	August 13	113
" 2nd "	" 29	" 15	" 9	" 19	112
" 3rd "	May 6	" 19	" 13	" 21	107
" 4th "	" 13	" 23	" 14	" 21	100
" 5th "	" 20	" 26	" 18	" 24	96
" 6th "	" 27	June 2	" 24	" 26	91
Ladoga, 1st sowing............	April 22	May 9	" 4	" 7	107
" 2nd "	" 29	" 15	" 7	" 11	104
" 3rd "	May 6	" 19	" 9	" 11	97
" 4th "	" 3	" 23	" 13	" 13	92
" 5th "	" 20	" 26	" 17	" 17	89
" 6th "	" 27	June 2	" 24	" 21	86
Carter's cross-bred I, or Anglo-Canadian 1 sowing only....	April 12	May 9	July 8	" 13	113

These results show that the number of days required by the different varieties of grain, from the time of seeding to harvesting, decreases with the successive sowings with considerable regularity. It is evident that the later sown plots were hurried in all their different stages up to the period of ripening. It will also be seen that the *Ladoga* wheat has matured on an average in seven days less time than the *Red Fife*, and in the single comparative test with the *Anglo-Canadian* the *Ladoga* is six days earlier.

Notes were taken at two or three different times as the season advanced, and more or less rust was recorded in every instance on all the plots; the terms "slightly," "considerably" and "badly rusted" being used to indicate increasing degrees of rustiness. Information was also gathered regarding the character of growth of each variety and the height of each sort at the time of harvesting. These details are presented in the accompanying table, where the condition of the grain as to rustiness is given from the notes taken just before harvesting.

DATES OF SOWING.	BARLEY.						OATS.		
	PRIZE PROLIFIC.			DANISH CHEVALIER.			PRIZE CLUSTER.		
	Condition as to rustiness.	Height.	Character of growth.	Condition as to rustiness.	Height.	Character of growth.	Condition as to rustiness.	Height.	Character of growth.
April 22	Leaves badly. Stems considerably.	3 ft. to 3 ft. 6 in.	Strong and even.	Leaves badly. Stems considerably.	3 ft. to 3 ft. 6 in.	Strong and even.	Leaves considerably. Stems slightly.	4 ft.	Strong and very even.
April 29	Leaves badly. Stems considerably.	2 ft. 6 in. to 3 ft.	Fairly even, a little patchy stands well.	Leaves badly. Stems considerably.	3 ft.	Fairly even, stands well.	Leaves considerably. Stems badly. Heads slightly.	3 ft. 9 in. to 4 ft.	Strong but patchy, badly lodged.
May 6	Leaves badly. Stems slightly to considerably.	2 ft. to 3 ft.	Medium to weak stands well.	Leaves badly. Stems considerably.	2 ft. to 3 ft.	Medium to weak, stands well.	Leaves considerably. Stems badly. Heads slightly.	3 ft. to 4 ft.	Strong and even, slightly broken.
May 13	Leaves badly. Stems considerably.	2 ft. to 3 ft.	Medium but patchy stands well.	Leaves badly. Stems considerably.	2 ft. to 3 ft.	Medium but patchy, stands well.	Leaves considerably. Stems and heads badly.	3 ft. to 3 ft. 9 in.	Strong, fairly even, considerably broken.
May 20	Leaves and stems considerably.	1 ft. 6 in. to 2 ft. 9 in.	Weak and very thin, many heads broken.	Leaves badly. Stems considerably.	1 ft. 6 in. to 2 ft. 9 in.	Medium to weak, patchy, considerably broken.	Leaves considerably. Stems badly. Heads considerably.	3 ft. to 3 ft. 9 in.	Strong, fairly even, badly lodged.
May 27	Leaves and stems considerably.	1 ft. 6 in. to 2 ft. 6 in.	Weak and very thin.	Leaves and stems considerably.	1 ft. 6 in. to 2 ft.	Weak, very patchy, stands well.	Leaves, stems and heads badly.	2 ft. 6 in. to 3 ft.	Uneven, one half badly lodged.

DATES OF SOWING.	OATS.			SPRING WHEAT.					
	EARLY RACE-HORSE.			RED FIFE.			LADOGA.		
	Condition as to rustiness.	Height.	Character of growth.	Condition as to rustiness.	Height.	Character of growth.	Condition as to rustiness.	Height.	Character of growth.
April 22	....	....	....	Leaves badly Stems considerably. Heads badly.	3 ft. to 3 ft. 9 in.	Very uneven and patchy.	Leaves and stems badly. Heads considerably.	3 ft. to 3 ft. 9 in.	Strong, stands well.
April 29	Leaves and stems badly. Heads slightly.	3 ft. 9 in.	Strong and even, badly lodged.	Leaves and stems considerably. Heads badly.	3 ft. to 3 ft. 9 in.	Uneven and patchy.	Leaves and stems badly. Heads considerably.	3 ft. to 3 ft. 9 in.	Medium, rather patchy slightly broken.
May 6	Leaves considerably. Stems badly. Heads considerably.	3 ft. to 4 ft.	Strong and even, broken in places.	Leaves badly. Stems considerably. Heads badly.	2 ft. 6 in. to 3 ft. 6 in.	Weak, considerably broken.	Leaves, stems and heads badly.	3 ft. to 3 ft. 6 in.	Weak and uneven, slightly broken.
May 13	Leaves considerably. Stems and heads badly.	2 ft. to 3 ft. 3 in,	Medium but patchy, considerably broken.	Leaves, stems and heads badly.	2 ft. to 3 ft. 3 in.	Very weak, considerably broken.	Leaves and stems badly. Heads slightly.	2 ft. 6 in. to 3 ft.	Very weak and patchy, slightly broken,
May 20	Leaves considerably. Stems and heads badly.	3 ft. to 3 ft. 9 in.	Strong but patchy, badly lodged.	Leaves considerably. Stems and heads badly.	2 ft. 6 in. to 3 ft. 3 in.	Weak, considerably broken.	Leaves and stems badly. Heads considerably.	3 ft. to 3 ft. 3 in.	Weak and patchy.
May 27	Leaves considerably. Stems and heads badly.	2 ft. to 2 ft. 6 in.	Strong but uneven, badly lodged.	Leaves considerably. Stems and heads badly.	2 ft. to 2 ft. 9 in.	Weak, considerably broken.	Leaves, stems and heads badly.	2 ft. to 2 ft. 9 in.	Very weak, badly broken.

The single plot of *Anglo-Canadian* wheat had the leaves badly, stems considerably and heads slightly rusted; the growth was uneven and patchy and the height 3 feet 6 inches to 4 feet.

It will be seen that all the varieties experimented with suffered from rust, the wheat being injured most. It is proposed to continue this line of experimental work next year at all the Experimental Farms.

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CENTRAL EXPERIMENTAL FARM.

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DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - CANADA.

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BULLETIN No. 9.

:o:

Results of the growth of Two-rowed Barley from Seed imported by the Government of Canada.

:o:

FEBRUARY, 1891.

CENTRAL EXPERIMENTAL FARM.

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Results of the growth of Two-rowed Barley from Seed imported by the Government of Canada.

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BY WM. SAUNDERS, DIRECTOR EXPERIMENTAL FARMS.

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A deep interest is felt in this subject at the present time by many Canadian farmers, but more particularly by those residing in those counties in Ontario where barley has been for many years one of the leading crops, and a general desire has been expressed to know the results of the many tests which have been made during the past season, especially with the variety which was imported by the Government for seed. The present bulletin contains these results as far as it has been possible to get them, nearly one-half of the farmers who joined in the test having reported.

When the Government, in February, 1890, decided, on the recommendation of the Minister of Agriculture, to place in the Estimates the sum of $25,000 for the purchase of two-rowed barley in England to be disposed of for seed in Canada, the announcement was received with general approbation. The prospect of a tariff high enough to exclude the greater part of the crop of Canadian barley from the United States had led Canadians generally to the conclusion that the wisest course was to look for markets elsewhere, and the only other country which could take our barley was Great Britain. An impression prevails in many minds that in order to sell two-rowed barley at all in the mother country for brewing purposes it must be produced to weigh 56 lbs. to the bushel, since this is the English standard weight for a bushel of that grain. This is an error. Any kind of barley of almost any quality, however poor, will sell in the

$1\frac{1}{2}$

British market, but the more inferior the grade the lower the price it will bring, and inferior barley from Canada would have to compete with the large quantities of barley of low grades which find their way to England from Russia and other European points, where farm labour is much lower than it is in this country. Since it costs as much to carry a bushel of inferior barley to England as it does to carry one of superior quality, and the question is not one of sale but of relative profit, the farmer here can only expect as his return the English figure, less the cost of transportation and commission, and when the price realized in Britain is low the highest figure which could be paid here would be too low to be remunerative to the grower.

The lower grades of barley, chiefly six-rowed, are used largely for feeding purposes and for distilling; the higher grades of two-rowed barley being in demand for malting and brewing, and for this purpose barley of high quality commands high prices. As a rule, the heavier and plumper the barley the better figure it will bring, the malting barleys varying in weight from 52 to 56 and in some cases to 57 lbs per bushel. There are, however, other points besides weight which influence buyers in the choice of barley for malting, such as mellowness and thinness of skin; but the full value of barley from any new source can be determined best by the character of the beer which results from the brewing. Chemical analyses have shown that barley of high quality is uniformly low in the proportion it contains of albuminoids or nitrogenous products; and as it has been shown that the six-rowed barleys grown in Ontario have a low proportion of nitrogen, and hence are higher in quality than the same class of barleys grown in the United States or Russia, and as it is altogether probable that this condition of the grain is brought about by climatic influences, there are good grounds for hope that two-rowed barleys grown under the same favourable conditions will possess that low proportion of nitrogen which will eventually prove an important factor in determining their value. From an average of 400 analyses published in Europe, extending over six years' crops, the fine two-rowed Austrian barleys average 9·61 per cent., those of England 9·69, Denmark 10·91, France 10·55, North Germany 11·21 and Russia 12·76. In the course of a special investigation into the composition of American barley made by the Chemist of the Department of Agriculture in Washington in 1876, the average proportion of nitrogenous products obtained from 12 analyses of Canadian

barley from Ontario was 9·83, while the average of those grown in different parts of the United States, leaving out California, was 11·50, California standing at10·50.

A number of samples, both of two-rowed and six-rowed barley, grown in different parts of Canada, are now being analysed by the Chemist of the Experimental Farm, Mr. F. T. Shutt, with the object of gaining further information on this subject.

Canadian six-rowed barley is preferred by brewers in the United States, because having a lower proportion of albuminoids it is better than that grown in their own country; and there is reason to hope that the same relatively high character may be established for Canadian two-rowed barley. If this be done there is no reason why the brewers of Canada and the United States should not also prefer the two-rowed barley, which finds such favour in Great Britain.

As soon as the Canadian Government had decided to place the sum referred to in the Estimates negotiations were begun for the purchase of the barley, and to save time the arrangements were made by cable, pending the receipt of samples which were forwarded by mail. After careful enquiry, 10,000 bushels of barley was purchased from James Carter & Co., of London, England, of the variety known as Prize Prolific, this being selected mainly for the reason that the experiments already made with this barley in Canada had given good results. It was brought out in 5,000 bags of 112 lbs. each, and on arrival carefully inspected, and as it was not found as clean as was expected the bags were all opened and the barley passed twice through the cleaning apparatus of the Montreal Warehouse Company, by which means the sample was made uniform and good, and although not absolutely clean, was, from a commercial standpoint, very clean. Not knowing how large the demand might be it was first offered to Canadian farmers, one bag only to each individual, at $4 per bag, freight being prepaid to the nearest railway station to the purchaser. As soon as the bulk of the orders were in, this limit of purchase was withdrawn, but the season then was too far advanced in the principal barley districts for the farmers to avail themselves of the offer of a further supply. Indeed in many instances, although every effort was made to secure prompt despatch, the barley purchased did not reach those who ordered it until a week or two after most of their grain was sown, and such late sowing lessens the yield, sometimes very materially.

About 3,200 bags were sold to 2,600 purchasers. Of these, 1,052 have sent in reports of the crop produced and samples of the grain as follows:—

Table showing results of tests of Two-rowed Barley (Prize Prolific), imported by the Government of Canada for Seed.

——	Number of Reports with Samples.	Yield per Acre.	Total Yield from 112 Pounds.	Weight per Bushel as Received.	Weight per Bushel after Cleaning.
		Bushels.	Bushels.	Lbs.	Lbs.
Ontario..............	872	25½	28⅓	50¼	51½
Quebec..............	48	20¾	22¾	48¼	50⅙
Nova Scotia	13	26½	26½	$47\frac{1}{10}$	48
New Brunswick......	23	$22\frac{1}{7}$	$24\frac{1}{11}$	47⅓	49¾
Prince Edward Island.	11	26½	27½	48	49
Manitoba............	62	39	43¾	48	50¾
North-West Territories	22	27½	$32\frac{1}{11}$	46½	50⅛
British Columbia.....	1	45¾	45¾	50½	53

Since the greater part of the barley exported to the United States is sent from the Province of Ontario, some of the information gained from farmers in that Province will be given prominence in this Bulletin. Out of the 872 reports received from Ontario, 337 report a yield of the crop after roots, and the average of these is 27¾ bushels per acre and the samples sent weighed as they were received 50⅓ lbs. per bushel. Many of the farmers who sent samples stated in their letters that they were sent just as they came from the thresher, and since such grain is not in a marketable condition it was thought only fair to the barley to make the samples merchantable by further cleaning. This was done by passing them all through a small fanning mill, which separated from 12 to 18 per cent. of the lighter grain and left the samples weighing on an average 51½ lbs. per bushel.

The results of those grown after other crops, given in 535 reports are as follows: Yield, 24½ bushels per acre; weight as received, 50⅕ lbs.; after cleaning, 51½ lbs. The average of the barley crop of Ontario for 1890, as given by the Bureau of Statistics, is 22·2 bushels per acre and this is based on the returns from 1,015 correspondents. On comparing the yield of two-rowed barley with this estimate, the barley grown after roots shows an average gain of 5½ bushels per acre and that grown after other crops of over 2 bushels; or, taking the average of the whole, the yield is 25½ bushels, or a gain of 3·3 bushels. Such a gain per acre on the barley acreage of

Ontario for 1890 would add $1,157,187 to the income of the farming community of the Province and still better results might be looked for with early sowing.

The following table, compiled from the "Statistics of Crops in Ontario," shows the average for eight years, from 1882 to 1889, inclusive, of the acreage in barley in the different counties, the yield per acre and the total yield, arranged in the order of precedence.

——	Acreage in Barley.	Yield per Acre.	Total Yield.
		Bushels.	Bushels.
York	58,018	29·6	1,714,907
Durham	47,780	27·3	1,305,325
Northumberland	46,597	22·7	1,058,473
Prince Edward	41,283	20·7	853,770
Lennox and Addington	40,500	22·3	902,331
Hastings	40,493	23·1	936,549
Ontario	39,537	29·	1,145,353
Wellington	35,998	28·3	1,019,802
Peel	35,592	28·	996,458
Simcoe	31,410	26·	816,671
Victoria	31,280	25·4	795,573
Huron	27,336	27·7	757,750
Grey	23,346	24·5	571,538
Bruce	19,419	25·9	502,371
Brant	18,652	27·6	514,581
Frontenac	18,634	23·	428,147
Perth	17,628	29·7	522,891
Oxford	17,079	30·1	513,778
Waterloo	16,573	30·8	510,269
Middelesex	15,096	26·7	402,656
Lambton	14,584	26·5	387,176
Haldimand	14,401	23·1	331,995
Peterborough	13,957	24·4	340,237
Halton	13,341	28·4	379,040
Wentworth	13,036	28·3	369,285
Dufferin	11,965	25·5	304,926
Leeds and Grenville	11,039	25·2	278,649
Carleton	7,875	29·4	231,160
Dundas	6,767	30·1	203,486
Kent	6,484	27·5	178,364
Norfolk	6,181	26·0	160,553
Elgin	4,397	27·5	120,960
Lincoln	4,346	25·4	110,460
Welland	3,824	23·9	91,581
Lanark	2,847	26·6	75,780
Prescott	2,774	27·3	75,722
Essex	2,754	27·3	75,062
Stormont	2,289	28·0	64,154
Glengarry	2,213	23·1	51,182
Russell	1,455	24·7	35,992
Renfrew	1,443	24·8	35,776
Parry Sound	649	22·9	14,860
Algoma	564	26·7	15,076
Muskoka	531	21·7	11,536
Haliburton	278	24·2	6,725
Totals for the Province	772,245	26·2	20,218,930

Last year (1890) the acreage fell off to 701,326 acres and the yield was 4 bushels less than the average of the previous eight years, which brought the total yield down to 15,600,169.

Extracts from the reports of farmers residing in the several counties will now be given, beginning with the most important barley county—York. Unless otherwise stated, the results given in each case are from the sowing of 1 bag of 112 lbs.

YORK.

Emerson Cooper, of Carrville, writes: "Sown 23rd April on light clay loam, after potatoes; harvested about ten days later than other barley; yield, 25 bushels per acre; total yield, 35 bushels. Seeded too thick to get best results. Are so pleased with the barley that we think of sowing none but this variety next season."

L. Cameron, of Elder's Mills, says: "Sown 2nd May on clay loam, after potatoes; could not tell exactly the area sown; total yield from 112 lbs., 2,580 lbs, (53¾ bushels). The land was in good order."

Wm. McDonald, of Hagerman, says: "Sown 21st April on good clay soil, after corn and turnips; harvested 4th August; yield per acre, 40 bushels; total yield, 80 bushels from 185 lbs. of seed. I am sure 1½ bushels of seed per acre would have produced a better result, the land being rich and well drained."

Wm. Farr, Woodbridge, writes: "Sown 3rd May on clay loam, after fall wheat; harvested 5th August; yield, 28 bushels per acre; total yield, 35 bushels. It yielded better than our Canadian barley, but barley was below an average yield this year. I intend sowing about 10 acres another year."

Wm. Grant, Markham, reports: "Sown 24th April on clay loam, after potatoes; harvested 9th August, yield, 28 bushels from 1¼ acres. The two-rowed barley yielded more straw than the the six-rowed and 2 bushels per acre more grain; was sixteen days longer in ripening."

Thos. Geer, Aurora, says: "Sown 18th April on light soil, after potatoes; harvested 8th August; total yield, 40 bushels, very near double the yield of my six-rowed on same kind of soil." Sample sent weighed 54 lbs. per bushel.

John W. Mably, Aurora, reports: "Sown 16th April on very light but rich soil; harvested 15th August; total yield, 39 bushels. The

Prize Prolific yielded 15 bushels more than the six-rowed, sown side by side. Some who got the two-rowed barley here got more than double that of the six-rowed." Weight of sample 52½ lbs. per bushel.

Joshua Willoughby, of Sutton West, got 33½ bushels from one bag sown; Wm. Irwin, of Nobleton, 43 bushels; James Mallory, of Teston, 36 bushels; Richard Batters, of Bond Head, 55 bushels; James Mustard, of Markham, 35 bushels; James Dobson, Schomberg, 33 bushels—he says: "It far exceeds my six-rowed barley." Alfred E. Keffer, of Concord, 30 bushels; Robert Fraser, of Bradford, 37½ bushels, who says: "I intend sowing at least ten acres next spring." N. A. Malloy, of Laskay, 30 bushels—he says: "I sowed too thick; at 1¼ bushels per acre the yield would have been better." T. F. Wallace, of Woodbridge, 36 bushels; Eli Wray, of Schomburgh, 40 bushels; Geo. Watson, of King, 30 bushels; Benjamin Bache, of Ravenshoe, 33 bushels; Thos. Cairns, of Laskay, 32 bushels; Isaac W. Fletcher, Humber, 38 bushels, and Wm. Morton, Holland Landing, 30 bushels per acre, who says: "I consider the two-rowed barley will prove a great advantage to our county."

DURHAM.

J. D. Treleven, of Hampton, had a yield of 35 bushels from one bag, and says: "I sowed this barley too thick; it stools out more than the six-rowed. I think 1¼ bushels sufficient to the acre. It averaged with me more than twice as much as the six-rowed."

John Mitchell, of Millbrook, had 37 bushels, of which he sent a nice bright sample, which weighed 53½ lbs. per bushel. He says: "It has a poor-looking head, and it all knuckled down, but it did middling well."

Geo. Gray, of Clarke, had 32 bushels, weighing 51⅓ lbs. He says: "I think the straw is going to be too soft, if this year was a proper one to go by. We had a great deal of rain here."

James Adams, of Newcastle, had 105 bushels off 3 acres, or 35 bushels to the acre. He says: "The crop would have been much better with a favourable season. We shall sow the whole product next year. The best yield of six-rowed barley in this locality was 20 bushels per acre."

John McNeill, of Cavansville, had a yield of 50 bushels on nearly 2 acres from 112 lbs., and states, that it "is a week later in ripening, but much better than six-rowed grown alongside."

Richard Barrett, of Newcastle, had a yield of $43\frac{1}{2}$ bushels per acre; weight per bushel 52 lbs.

Richard Varcoe, of Newcastle, had 27 bushels per acre, weighing $53\frac{1}{3}$ lbs. per bushel. He says: "I intend to sow the total yield next year."

Richard Good, of Bowmanville, had a yield per acre of 25 bushels. He says: "This has been a very poor year for barley in this section; six-rowed averaged about 15 bushels."

Robert Cascaden, Wesleyville, had 25 bushels per acre, or a total of 35 bushels weighing $52\frac{1}{4}$ lbs. per bushel. He says: "My land is low, and season being wet and cold my barley had no chance; there was one high knoll on the patch and it was grand, good enough looking for 45 bushels per acre."

Thos Medd, Millbrook, had 40 bushels per acre, weighing 53 lbs. per bushel.

Joseph Bland, Mount Pleasant, had 28 bushels per acre, says: "It was a very bad barley season in this part."

NORTHUMBERLAND.

Geo. Farr, of Harwood, sowed his bag on less than an acre; had a total yield of 35 bushels, or at the rate of 40 bushels per acre, weighing 53 lbs. per bushel. He says: "Sowed 3rd May on clay loam, after roots, harvested 15th August. Had I sown 2 acres with the same quantity of seed I would have realised about double the yield; am satisfied with the barley; think it will do well on my farm. I intend sowing quite a quantity next year."

Wm. Cochrane, of Colborne, had a yield from 1 bag of 34 bushels, weighing $52\frac{1}{4}$ lbs. per bushel says: "Sown about 12th May, on clay loam, after oats; harvested 4th August. I am well pleased with the grain; it was the best crop raised in this section. I am going to give it a fair trial another year."

F. Boneycastle, of Campellford, had 25 bushels per acre, after fall wheat. He says: "Turned out better than the six-rowed, but has a very weak straw."

John L. Grogean, of Cobourg, had a total yield of 24 bushels on $1\frac{1}{5}$ acres. He says: "Spring very wet; about $\frac{1}{4}$ acre was drowned out; yielded better than the six-rowed barley; it will not lodge like the six-rowed; straw not so long, and brighter."

W. B. Huyck, of Castleton, had 18 bushels per acre. He says: "Although this is a small yield, it is considerably better than the six-rowed did, which was the poorest ever grown in this section on account of heavy rainfall. I think well of it."

G. L. Duncan, of Colborne, had 21 bushels per acre. He says: "about one-third of my crop was drowned out with heavy rains; a poor crop, but better than the six-rowed barley this year."

W. T. Burnham, of Cobourg, had a total yield of 54 bushels from one bag or 39 bushels per acre, weighing 53¼ lbs. per bushel. He says: "The season was much against it, on account of so much rain."

Jacob R. Harris, Warkworth, had 30 bushels from one bag sown. He says: "One-third of this was sown at 2 bushels per acre, one-third at 1½ bushels, and one-third at 1 bushel. That sown 1 bushel per acre was best; the barley was injured by heavy rains."

Thos. Gibson, Newcastle, had 35 bushels from one bag sown. He says: "I think it can be grown successfully in this county."

Thos. Clarke, of Brighton, had 21 bushels per acre. He says: "Season was very unfavourable; had six-rowed barley alongside of it, and the two-rowed was equally good, if not better. The wet drowned part of it out."

PRINCE EDWARD.

James R. Anderson, of Mountain View, had a total yield of 40 bushels, 32 bushels per acre, weighing 53⅗ lbs. He says: "Sown 21st April on black clay; preceding crop, barley; harvested last week in July. I sowed my bag on 1¼ acres of ground; had I sown it on 1¾ acres I would have had a much better crop, When it began to stool it was altogether too thick to do well. I showed it at the fairs near by and took the first prize on it; am well pleased with the way the barley has turned out."

Geo. C. Hurlburt, of Cressy, had a total yield of 39 bushels, weighing 53 lbs. per bushel. He says: "About ten days later than six-rowed; preceding crop, barley. I sowed on ordinary soil; had no extra chance; the yield was double that of the six-rowed."

Elkanah Babbitt, of Rossmore, had 50 bushels from one bag sown on 1½ acres. He says: "I am well pleased with this year's trial; the yield was more than double that of our common six-rowed, which had as near the same chance as possible."

Dr. Edward Kydd, of Picton, had a total yield of 25 bushels. He says: " It yielded better than my other barley on similar soil; will try it again next year."

Geo. F. Affir, of Picton, had a similar yield of 25 bushels. He says: "It yielded better than my other barley; am well satisfied, and will sow next year"

Alex. H. Anderson, of Rossmore, had 20 bushels per acre; total yield, 26 bushels. He says: "Preceding crop, six-rowed barley. I used no manure in the field, and sowed six-rowed barley in same field alongside of it, as I wished to see which would do the best. I found the two-rowed far exceeded the other in straw and yield."

G. J. Walmsley, Waupoos, had 22 bushels per acre. He says: " I think it does better than the six-rowed barley.

Oscar Bristol, Demorestville, reports a total yield of 60 bushels, or 30 bushels per acre. He says: "I am well pleased with the two-rowed barley."

W. S. DeMill, Picton, had 130 bushels from five bags sown, and says that his two-rowed yielded much more than the six-rowed. " Am satisfied we can make it a success".

John J. Young, Consecon, sowed his bag on 1½ acres, and had a yield of 40 bushels. He says "The two-rowed barley yielded about one-quarter more than the six-rowed did."

W. C. Killup, Consecon, had 25 bushels, and says: "This two-rowed barley turned out better than the six-rowed sown in the same field."

James Arthur, of the same place, had 27 bushels per acre, or a total yield of 40 bushels.

Enock A. Mills, Demorestville, had 26 bushels per acre, or a total yield of 40 bushels. He says: " It was late sown, but did very well after all; it gives very good satisfaction."

LENNOX AND ADDINGTON.

J. J. Watson, Adolphustown, had 33 bushels from one bag sown. He says: "Sown 21st April; harvested 31st July; the six-rowed barley was the poorest of any crop this year in this section."

Thomas Gurran, Sandhurst, had 45 bushels from one bag sown, or 30 bushels to the acre. He says: " I sowed it about one-fourth too thick; would have had 60 bushels if sown on more ground."

Lewis Hastman,, Odessa, reports a yield of 18 bushels from 1 bushel, and says: "Six-rowed barley turned out about 10 bushels from 1 in same field."

David T. Finley, Stella, had a total yield of $42\frac{1}{2}$ bushels from two bags sown, and says: "I am well pleased with the two-rowed barley for this unfavourable season. I did not receive it early enough; my six-rowed was up before the other arrived." He also states that his two-rowed barley, although so late sown, yielded better than the six-rowed.

John Galbraith, Camden East sowed one bag on 1 acre, and had a yield of 20 bushels. He says: "I find 2 bushels to the acre too much; $1\frac{1}{4}$ bushels would be quite enough, as it is a great barley to stool, some roots having as many as ten shoots. The six-rowed barley in this section was not half a crop."

Jas. Cousins, Enterprise, had 30 bushels to the acre, 75 to 80 bushels from two bags, and says; "Sowed six-rowed same day in same field, all conditions alike; the two-rowed gave 8 to 10 bushels per acre the better yield."

J. D. Wager, Enterprise, had $34\frac{1}{2}$ bushels per acre, or a total yield of 40 measured bushels from one bag. He says: "Had six-rowed barley in same field, same treatment; yield only $16\frac{1}{2}$ bushels from one, and lighter barley."

N. B. Hough, Sillsville, had 37 bushels from one bag sown. He says: "Part of it was hurt with wet weather; otherwise, I think there would have been 45 to 50 bushels."

Peter D. Davis, Dorland, had a total yield of 35 bushels, or 25 bushels per acre.

Micheel McKeever, Sandhurst, reports a total yield of 30 bushels, and John Marshall, Stella, 24 bushels per acre. He sent a sample which weighed 53 lbs. per bushel, and says: "The barley was half drowned out; think it will do well here."

HASTINGS.

S. E. Lane, Wallbridge, sowed one bag on 1 acre, and had 23 bushels, and says: "It yielded about 7 bushels to the acre more than the six-rowed barley, and stands the wet weather better."

Alex. Morton, Thomasburg, had a yield of 30 bushels, or 24 bushels per acre, and says: "It would have yielded better had it not blown down; is a week or a week and a-half later than six-rowed."

Henry Fern, Foxboro', had 28 bushels, and says: "I believe we can raise the barley if you can get us a market for it."

John Toppings, Marysville, sowed his bag on 1 acre, and got 30 bushels. He says: "I sowed it too thick."

Alex. Miller, Frankford, had a yield of 30 bushels, or about 20 bushels an acre, and says: "Sown 28th April; harvested 15th August. The seed weighed 55 lbs. per bushel, the yield only 51. Six-rowed growing in the same field beside it weighed 48 lbs. and about the same yield per acre."

Jos. Haggerty, West Huntingdon, sowed one bag on nearly 1½ acres and had 32 bushels. He says, "Sown 8th May; barvested 12th August. Straw quite soft; lodged badly; sowed 1 bushel in field with six-rowed, which stood much better; all our barley almost a failure this season; think it should be sown very early, and am of opinion it will do well. I intend sowing next spring."

Robert Bush, Frankford, had 31 bushels, or 23¼ bushels per acre, and says: "I liked it very well; had a bigger yield than any one in our neighbourhood."

John H. McColl, of the same place, sowed his bag about 1½ bushels per acre, and had 28 bushels. He says: "I didn't give this barley any extra chance; I sowed it on one side of a field with my six-rowed barley; I don't think the two-rowed barley yielded quite as much per acre as my own barley."

W. N. Ponton, Belleville, who had 26 bushels from one bag, says: "A larger yield than the ordinary Canadian barley, which this year did not hold out its usual weight and was very poor." The sample sent by Mr. Ponton weighed 53 lbs. per bushel.

Wm. Arbuckle, Thomasburg, had 35 bushels from one bag of seed, and says: "Took first prize at Township show. D. McFarlane, Melrose, 35 bushels; John Leverton, Shannonville, 32 bushels, and Charles Long, Blessington, 27 bushels, who says: "I am well satisfied with it, comparing it with the growth of six-rowed barley."

P. R. Daly, of Belleville, had 24 bushels from one bag sown, and says: "The seed arrived late, and I was obliged to sow it upon unsuitable ground; still, it beat my six-rowed in quantity and quality. I intend to sow all that it produced, and will try and give it a fair trial the coming season."

ONTARIO.

James Tran, Green River, had 40 bushels per acre, or 44 bushels in all. He says ": Sown 6th May. I think the barley did very well for the chance it got; land was not fall-ploughed, only gang-ploughed in the spring; barley crop poor here, only averaging about 20 bushels per acre. For the last 25 years have not raised less than 25 to 50 bushels; this year I had only 24 bushels per acre."

Mr. Coates, Shirley, had 32 bushels from one bag of seed, and says: "We liked it very well; will sow about 10 acres next year."

Thomas Stonehouse, Cannington, had 2,000 lbs. (41 bush. 32 lbs.) from one bag sown, and says: "A splendid crop; great yield; far ahead of the six-rowed; will sow 27 acres of this barley next spring; has a strong, rank straw; will only sow 1 bushel to the acre next season, as it stools out very much."

Geo. Ruttle, Brechin, cleaned up 30 bushels per acre, says: "This barley had not a good chance, but did better than the six-rowed beside it; was strong in the straw, and did not rust; the six-rowed rusted badly."

William Pearson, Manchester, had 40 bushels from one bag of seed, and says; "I am satisfied that I can raise more per acre of the two-rowed than I can of the six-rowed. I intend sowing about 60 acres next spring."

Robert Brabagon, Wick, had 35 bushels, and says. "I had about three times as much two-rowed barley on the same farm as I had of the six-rowed.'

John Forsyth, of Glasgow, had 28 bushels, and says. "The yield would have been much larger had it not been for the heavy rains. Our Canadian barley in the same field produced scarcely 20 bushels to the acre. The two-rowed produced more straw than the six-rowed."

A. P. McDonald, of Millington, had 30 bushels 40 lbs. per acre, and says. "This year was very unfavourable for barley in this part of Ontario; six-rowed, which usually does well, was a failure. The two-rowed barley did much better with me on the same soil. I believe it will be a success if the farmers will prepare the ground properly for it."

Thos. Waddell, Beaverton, had a yield of 40 bushels from one bag on 1⅓ acres. Robert Bruce, Brechin, 40 bushels per acre; Wm. Oak,

Beaverton, 40 bushels per acre; Wm. Jeffrey, Brooklin, had 60 bushels from $1\frac{1}{2}$ acres; Wm. Brent, Raglan, 40 bushels per acre. He says: "I think if I had received the barley ten days sooner it would have done better, although I think it did first-rate." Wm. Brain, Beaverton, had 30 bushels 27 lbs. per acre; B. T. Brown, Gamebridge, 41 bushels per acre; R. S. Vickrey, Prince Albert, 40 bushels off $1\frac{1}{8}$ acres; James Found, Dumbarton, 35 bushels per acre, he says, "The season was damp; there was a heavy crop of straw, and it went down a good deal, which lessened the yield." W. Eyres, Cannington, had 35 bushels from one bag, or 30 bushels per acre; John Martin, Raglan, 32 bushels per acre; James Trull, Whitby, 30 bushels per acre; C. Harleston Irving, Newmarket, 30 bushels. He says, "I intend to sow 10 or 12 acres next spring. John H. Whitfield, Port Perry, reports 35 bushels per acre; and Wm. Blackwell, Cannington, 32 bushels per acre, total yield from one bag, 40 bushels, who says: "Sowed six rowed barley in same field; yield per acre 20 bushels."

WELLINGTON.

Geo. Wright, Elora, had 40 bushels per acre or 45 bushels in all from one bag. He says, "I intend to sow Carter's Prize Prolific next season." Charles Gillies, Mount Forest, had 30 bushels from one bag sown, and says: "It has yielded about 5 bushels more to the acre than six-rowed barley."

H. A. Hunter, Orangeville, had $32\frac{1}{2}$ bushels per acre, and says: "Bright, and 4 lbs. per bushel heavier than six-rowed barley grown in the same field."

Geo. Haycock, Aberfoyle, had 26 bushels per acre, and says: "It did well for the chance it had; could have sown it 15 days sooner if I had it. It yielded far better than the Canadian barley, and stands up well. I intend sowing it all next spring on a better piece of land."

John Shaw, West Luther, had a yield of 32 bushels, and says: "Shall not sow any six-rowed barley next season."

J. Riordan, Arthur, had 40 bushels, and says: "Sowed my bag on exactly 1 acre; if put on $1\frac{1}{4}$ acres the yield would have been better I will manage the sowing better another season."

John Given, Ballinafad, had 34 bushels from one bag, about 25 bushels per acre, and says: "I think that with good cultivation it would do well here, and that seems to be the prevailing opinion."

Jas. W. Burns, Rockwood, had 30 bushels per acre, and says: "When it came out in head a destructive storm laid it flat; but for this I feel certain we would have had 40 bushels."

Jas. McNaughton, Gourock, had 80 bushels from two bags, or about 40 bushels to the acre, and says: "I am very much pleased with the two-rowed barley. I have had a number of farmers asking for seed."

Thos. E. Walsh, Guelph, had 38 bushels from a bag, or 30 bushels per acre, and says: "It was sown too thick, also too late, but the yield was better than the six-rowed barley under the same conditions."

L. D. Crewson, Grand Valley, had 30 bushels per acre, and says: "Will sow mostly of it next season." Geo. W. Thompson, Guelph, 30 bushels; Judson W. Crewson, Grand Valley, 35 bushels, or 30 bushels per acre; Robert Fyfe, Harriston, 30 bushels; E. Mooney, Orton, 32½ bushels; James Davey, Grand Valley, 30 bushels; A. F. McGill, Hillsburg, total yield, 38 bushels, 30 bushels per acre; John Allen, Riverstown, 34 bushels per acre; Robert A. Patullo, Vanatter, had 28 bushels; Richard Gaffery, Mount Forest, 30 bushels, who says: "I think it might do very well in this country;" and Chas. Drury, Arthur, got 38 bushels.

PEEL.

Geo. Douglass, Graham's Station, had a total yield of 40 bushels, says: "Sown 15th May on not very rich soil; harvested 12th August. I believe it is a very good barley for this climate, and if sown on good soil would be very profitable."

Geo. Sheard, Woodhill, had 32 bushels per acre, and says: "Sown 10th May, on clay loam; harvested 20th August. The yield is greater by 30 per cent. than six-rowed barley with me." G. S. Boyes, also of Woodhill, had 30 bushels, and says: "Season was unfavourable for barley; this was about two weeks longer maturing than common six-rowed."

John Craig, Sandhill, had 28 bushels per acre, and says: "I can recommend the barley; there was no manure put on this field for six years and it was a very wet season. It stood the storms well. I cut it with my binder, and had to mow the rest of my barley. I intend sowing all I have on hand."

Joseph Wiggins, Claude, had a total yield of 34¼ bushels, or about 30 bushels to the acre, and says: "In a good season I would have had 50 bushels." F. Lundy, Brampton, total yield 35 bushels, 30 bushels

per acre who says: "If it had been a favourable season, would have had at least 10 bushels more." Henry Richardson, Burnhamthorpe, had about 36 bushels per acre, and says, "It did not get a fair chance this year. I intend to sow 10 acres next season, and would advise all farmers to give this barley a chance." James Lyons, Salmonville, 28 bushels, says, "It was a week later ripening; I think I sowed it one-half too thick." Wallis Dunn, Cooksville, says: "I got about 20 bushels, which I intend to sow next season. The yield was fully as good if not a little better than the six-rowed."

SIMCOE.

David Wamman, Orillia, had a total yield of 36 bushels, 30 bushels per acre, and says: "Sown 24th April on a strong loam; harvested 6th August. I am well satisfied with the yield this year; it was not a favourable season."

Wm. Neve, Dalston, had 46 bushels per acre, weighing 53$\frac{1}{3}$ lbs. per bushel, and says: "I believe it is a good kind of barley."

Thos. B. Murray, Avening, had a yield of 52 bushels, 34 bushels per acre. He says: "The straw was very light, and it appeared to be a light yield, but when you examined the head it was plump, and from 30 to 40 grains in good heads."

Robert Lawrence, Honeywood, had 31 bushels, or 30 bushels per acre, and says: "I propose sowing all of mine next season, as its yield compares favourably with the six-rowed."

Geo. Newby, Lovering, got between 40 and 50 bushels, and says: "I am going to sow no other kind next year but the two-rowed barley."

Thomas Casey, Crossland, had 40 bushels per acre, and says: "Sowed six-rowed barley in the same field; it yielded 10 bushels less per acre."

Lambert Wilson, Churchill, divided his bag with a neighbour; had 24 bushels from 1 bushel sown on a little over half an acre, and says: "It yielded much better than our six-rowed barley."

Wm. Draper, Cookstown, had 30 bushels per acre, and says: "This was sown alongside in same field with six-rowed barley, and the two-rowed yielded the best."

John Darby, Crown Hill, had 30 bushels, sowed one bag on 1 acre, and says: "It was too thick on the ground; shall sow 1$\frac{1}{2}$ bushels next season."

Edward Pentland, Collingwood, got 34 bushels.

R. W. Benton, Crossland,—total yield, 50 bushels. R. T. Kearns, about 32 bushels per acre.

Sheldon Brooks, Holly, 30 bushels. Asks: "What do you think of this sample of barley." It was a good, bright sample, weighing 54 lbs. per bushel.

John A. Brest had 40 bushels, 35 bushels per acre, and says: "Sowed too thick; I think it will do well."

James Kerr, Avening, 49 bushels 35 lbs. on 1 acre.

VICTORIA.

John Calvert, Reaboro, got about 40 bushels per acre, and says: "I would advise to sow 4 pecks per acre, many of my neighbours sowed $1\frac{1}{2}$ bushels, and it went down more than that thin sown."

W. H. Teherne, Downeyville, had 42 bushels from $1\frac{1}{4}$ acres.

John Campbell, jr., Woodville, sowed one bag on 2 acres, and had 60 bushels. He says: "I think had it been sown a little thicker it would have yielded better. I am so pleased with it I shall sow no other barley the coming season."

Samuel Mitchell, Dunsford, had 40 bushels on a little over an acre, and says: "Sowed it too thick, and it lay down. I never had a crop that paid as well; am selling it to my neighbours at $1 per bushel."

Thomas Newman, Lindsay, had 50 bushels from about an acre, and says: "Sown too thickly; think it did fairly well, better than six-rowed barley.

John Westlake, Manilla, had 40 bushels per acre, and says: "The two-rowed did better in this part than the six-rowed." Joseph McGahey, Eden Valley,—total yield 51 bushels, 38 bushels per acre. says: "We like it well." Issac W. Read, Reaboro, total yield, 50 bushels; 30 bushels per acre; J. S. Cruess, Cambray, about 30 bushels per acre; James Taylor, Oakwood, 41 bushels from one bag sown on a little over one acre. He says: "I am more than satisfied with my returns of this barley." Thos. Delehay, Reaboro', 30 bushels; Alex. McGee, Fenelon Falls, about 40 bushels on $1\frac{1}{8}$ acres; Thos. Robinson, Omemee, 30 bushels per acre, who says: "The two-rowed yielded more per acre than any six-rowed I sowed."

HURON.

Andrew Taylor, Londesborough, had 35 bushels per acre. He says: "Am tolerably well satisfied with the results, considering the chance it had. My six-rowed barley yielded 28 bushels per acre."

Alex. Gardner, Brussels, had 36 bushels. He says: "This sample took first prize at East Riding show against all other varieties of two-rowed."

Richard Armstrong, Brussels, had 30 bushels per acre, and says: "It did better with me than the six-rowed barley."

Peter Cantlon, Porter's Hill, had 40 bushels from one bag, sown on 1¼ acres of land. He says: "It would have been better if it was not sown so thick; but it made a better yield than the six-rowed barley in the same field beside it."

Charles McKea, Belgrave, had 40 bushels per acre. He says: "I am well pleased with the result."

O. Creswell, Egmondville, had from 42 to 45 bushels to the acre. Says: "I am well pleased with the result."

John McDowall, Westfield, had 30 bushels per acre. Says: "I am going to sow 6 acres in the spring of this barley."

Samuel Ferris, Holmesville, had a total yield of 40 bushels, 35 bushels per acre. Says: "It's yielding qualities are all that could be desired, being almost double that of the Canadian, sown side by side."

Wm. Burrows, Goderich, had 36 bushels per acre, which weighed 54 lbs. per bushel; T. Colbur, Goderich, 31 bushels of similar weight per bushel; Henry Warren, Clinton, had 30 bushels per acre; Wm. McCracken, Brussels, a total yield of 40 bushels; Sam. McBurnie, Wingham, had 84 bushels from two bags sown.

James Aulton, Belfast, had 30 bushels. Says: "Barley was a very poor crop around here this year."

P. H. Elliott, Holmesville, had a total yield of about 50 bushels.

Alex. Cox, Porter's Hill, had a total yield of 45 bushels, 36 bushels per acre.

Wm. Bryans, Belgrave, had 30 bushels per acre. Says: "I think the two-rowed barley will do well in this country."

Wm. Johnston, Wingham, had 30 bushels, and Malcolm McTaggert, of Clinton, 28 bushels per acre.

GREY.

John White, Meaford, had 46 bushels 32 lbs. from one bag sown on 1 acre, weighing 53 lbs. per bushel. Says: "The barley exceeds my expectations."

W. S. Porter, Oxenden, had 45 bushels per acre. Says: "I think this barley will do very well in this section."

Thomas McArthur, Flesherton, had 41 bushels 16 lbs. per acre. Says: "This barley will do well in this country; ripens about ten days later than six-rowed."

John J. Vickers, Heathcote, had a total yield of about 40 bushels.

E. Berwick, Shelburne, had 33½ bushels per acre, 235 bushels from 7 bags, sown one bag per acre. Says: "Crop was much too thick; think the yield and quality would both have been a good deal better if sown thinner."

Thomas Kells, Vandeleur, had 31 bushels per acre. Says: "I believe the County of Grey just the place to cultivate this barley with success."

Daniel McMichael, Shelburne, had 40 bushels per acre. Says: "It ripened very well. A good part of it was laid down; but for all that it was a good crop."

W. G. Noble, Horning's Mills, had 30 bushels per acre; says it gave him satisfaction.

Hugh McCorkindale, Desboro', had 20 bags from 112 lbs. sowed, and says: "The best yield I ever saw for barley."

Thomas Brown, Lake Charles, had a total yield of 40 bushels, or 32 bushels per acre. Says: "Sowed the bag on 1¼ acres, and it stooled out so that it was altogether too thick."

H. Rozel, Egremont, had a total yield of between 35 and 40 bushels.

G. Adams, Walter's Falls, had 36 bushels. Says: "The ground I did not consider at all favourable for the crop, but I wanted to see what it would do under unfavourable conditions, and I am well satisfied with it, as it was a heavy crop."

Wm. Stephens, Cedarville, reports a yield of about 50 bushels per acre, and Chas. Emery, of Meaford, 48 bushels per acre.

BRUCE.

Peter Watson, Lucknow, had a yield of about 50 bushels from one bag, or 40 bushels per acre. Says: "Sown 8th May; harvested 9th August. It did very well for the first time of sowing."

M. Campbell, Lucknow, had 50 bushels from one bag, or 43 bushels per acre. Says: "This lot took second prize at the Lucknow Agricultural Show. Is about eight days later than the old barleys sown, but is heavier and better grain."

Oliver Cole, Kincardine, had 24 bushels. Says: "My experience in this one trial is that for feed I would prefer the two-rowed barley to the six-rowed."

J. Taylor, Cargill, had 30 bushels per acre.

Wm. Cannon, Chesley, had a yield of 37 bushels, or 30 bushels per acre. Says: "Barley was received too late to give it a fair chance. It was somewhat inclined to lodge; will give it a better chance next year."

BRANT.

J. B. Howell, St. George, had 40 bushels from one bag sown. Says: "I find this barley great for stooling. Quantity sown was 1½ bushels per acre; 1¼ is plenty. Intend sowing 6 acres the coming season."

A. Clement, Paris, had a total yield of 30 bushels, 24 bushels per acre. Says: "It yielded a little better with us than the six-rowed variety, which only gave 22 or 23 bushels per acre, although we usually grow 35 as an average crop."

H. E. Egleston, Ancaster, had a total yield of 40 bushels, 30 bushels per acre. Says: "Sown a little late in the season; wants to be in early and on land not too strong."

James Richmond, Washington, had 36 bushels per acre. Says: "The common barley was not so good in that same field."

David Shultis, Rockwood, had 21 bushels per acre. Says: "The barley was sowed on the worst field on the farm, and water smothered part of it. I had six-rowed barley in the rest of the field, which was almost a total failure."

S. B. Lawrason, St. George, had 36 bushels per acre. Says: "Sowed one bag on 1 acre; was too thick; 1¼ bushels per acre would be plenty."

Thomas Aulsebrook, Paris, had a total yield of 36 bushels, 30 bushels per acre. Says: "I think it would have been better if sown two weeks sooner."

Charles Baxter, Drumbo, total yield 36 bushels; W. B. D. LaPere, Paris, had 79 bushels from 2 bags sown.

George Aitkins, Glen Morris, had a total yield of 38 bushels, or 30 bushels per acre. Says: "It stood the heavy rains as good as the six-rowed—I mean, it did not lodge any worse."

H. D. G. Hamner, Mount Vernon, had a total yield of 40 bushels, 27 bushels to the acre. Says: "The season has not been as favourable as last year. I believe with high cultivation and favourable weather a fair sample can be produced." Mr. Hamner's sample weighed 52½ lbs. per bushel as received.

Robert Spiers, Richmond, had a total yield of 38 bushels, 30 bushels per acre. Says: "Suited very well; will sow again, but not so thick."

John Taylor, Lancaster, had 53 bushels per acre. Says: "I intend to sow 14 acres in spring if I can find a market."

FRONTENAC.

R. J. Dunlap, Kingston, had a total yield of 31 bushels, about 30 bushels per acre. Says: "The two-rowed barley did better generally than the six-rowed. I think there will be no trouble growing it."

Stephen Fairfield, Collin's Bay, says: "I had a total yield of 45 bushels, about 18 bushels per acre. I was very well satisfied with the barley. It did very well this season, although the weather was against it. I think it will answer in this part of Ontario."

James F. Gibson, Cataraqui, had about 30 measured bushels per acre, and says: "I think we can grow this barley, if we can only find a market for samples such as I sent you. I am afraid we cannot make it 56 lbs. to the bushel." Samples sent weighed 51 lbs. as received and 52½ lbs. after cleaning.

PERTH.

James Wilson, Mitchell, had 45 bushels per acre. He says: "I am well pleased with the grain; think it did better than the ordinary barley. My 2 bushels were sown broadcast on rather less than an acre. We had 20 full bags from the threshing machine. Have a number of applications for the grain."

Thomas Driver, St. Mary's, had 40 bushels per acre. He says: "The barley has done very well indeed. I think it will be suitable to the country."

F. G. Ballantyne, Atwood, Ont., had 40 bushels per acre. He says: "It does not suit this climate; season rather short, but will try it next year." No sample was received with this report.

Robert Simpson, Sebringville, reports a total yield of about 40 bushels.

Wm. Makin, Stratford, had a total yield of 28 bushels. He says: "It would have been a big yield, but it got lodged with storms in June."

Alex. Crawford, Linwood, had a total yield of 34 bushels.

Henry Lawrence, Mitchell, had a total yield of 34⅔ bushels, or 26 bushels per acre. He says: "It looked beautiful until the heavy rains in June; then the lower leaves turned yellow and the rust struck it, which hindered the yield a great deal."

Messrs. Hay Bros., Listowel, Ont., had a total yield of 30 bushels. They say: "Past season too much rain, and fear it will not work in this locality." This sample was one of the heaviest of all the samples received from Ontario.

John Miller, St. Mary's, had a total yield of about 50 bushels. He says: "Sown with drill at the rate of 1¼ bushels per acre. One bushel would have been enough."

George Langford, Milverton, reports a total yield of 37 bushels, or 30 bushels to the acre.

OXFORD.

J. D. Eddy, Scotland, had a total yield of 35 bushels. He says: "I think early sowing very important. Everything considered, am well satisfied. Will plant all of my seed the coming spring."

Henry Hewitt, Bright, had a total yield of 30 bushels, or 28 bushels to the acre, and says: I am well pleased with the barley, it is the best we grew this year out of 26 acres."

Patrick Carney, Eastwood, had a total yield of 45 bushels. He says: "My opinion is that it will be the coming barley."

George Weir, Cathcart, had 30 bushels from one bag sown. He says: "We sowed the rest of the field with the common six-rowed variety, which grew and ripened much earlier but did not turn out so well."

M. Payson, Bright, had 36 bushels or 24 bushels per acre. He says: "Sowed part of it at the rate of 1 bushel per acre, the rest at 1½. Thin seeding thick enough. Best sample of barley weighed 53 lbs. to the bushel. Yielded as well as Canadian barley grown in the same field on land prepared the same. Would grow all English barley if I thought we would have a good market for it."

John Cuthbert, Sweaborg, had 30 bushels per acre. He says: "I sowed my six-rowed barley at the same time and alongside of Carter's Prize Prolific. The latter turned out the best, and also stood up the best. Season was not favourable for barley in this section. I am satisfied we can raise "Prize Prolific" if you can find a market."

James Virtue, Woodstock, had a total yield of 40 bushels from one bag, at the rate of 30 bushels per acre. He says: "Season wet and unfavourable for barley. Had six-rowed growing alongside of two-rowed. Have done away with the six-rowed and will sow nothing but two-rowed."

William Roberts, Medina, had 32 bushels from 1⅛ of an acre. He says: "At the time of ripening we had four or five weeks of hot, dry weather, which hastened the ripening at least ten days and injured the crop."

William Donaldson, South Zorra, had 35 bushels to the acre.

George Allen, Oriel, had a total yield of 30 bushels, 24 bushels per acre. He says: "Barley in this section this year is far below the average yield."

WATERLOO.

Alex. McPhail, Galt, had 36 bushels from 1 acre. He says: "It was eight days later in ripening than the six-rowed, yielded fully as well as the six-rowed, stood up well."

Thomas Allison, Galt, had 31 bushels per acre. Sowed one bag on an acre. He says: "I sowed too thick. If sown early on good ground and not too thick, I am satisfied it would do better."

C. Mundy, Breslau, had 30 bushels per acre.

George Oliver, Galt, had 25 bushels from 1 bushel sown. He says: "Believe it will do well, and yield as much to the acre as six-rowed will."

Andrew Herman, Elmira, had a total yield of 33 bushels, 27 bushels per acre.

G. Dorin, Wellesley, reports a yield per acre of about 35 bushels.

R. Campbell, New Hamburg, 27 or 28 bushels and Wm. McKenzie, Galt, 35 to 40 bushels per acre.

MIDDLESEX.

John Wallis, Ferguson, had a total yield of 39 bushels, or 35 bushels to the acre. He says: "Our six-rowed in the same field is not so productive or heavy. For feeding, we are satisfied that it is far superior to six-rowed."

John C. Zavitz, Amiens, had 20 bushels per acre. He says: "Wet weather in June hurt my barley. It yielded better than the six-rowed by the side of it, and was better in quality."

Thomas Redway, Harrietsville, had 32 bushels per acre. He says: "My Canadian barley went 27 bushels to the acre."

William Pentall, Exeter, had 35 bushels per acre.

Henry Anderson, Wilton Grove, had a total yield of 36 bushels, or 30 bushels per acre.

G. H. Marlock, Crediton, had 36 bushels per acre.

Andrew Duncan, Springfield, had a total yield of 33 bushels.

Charles Harvie, Exeter, had 30 bushels per acre. He says: "It yielded as well as the six-rowed in the same field, but went down bad where the land was strong."

Thomas Sharpton, Exeter, had a yield of 40 bushels from $1\frac{1}{3}$ acres.

Angus Campbell, Appin, 32 bushels. He says: "I am well pleased with the English barley and intend to sow 10 acres of it in the spring."

C. J. Hayes, Park Hill, had a total yield of 38 bushels, or $27\frac{1}{2}$ bushels per acre.

Samuel S. Michel, Strathroy, had 55 bushels from one bag sown on 1¼ acres.

Richard Haskett, Park Hill, had a total yield of 43 bushels, or 34 bushels to the acre.

Gerad Brown, Exeter, had a total yield of 35 bushels. He says: "Will sow most of the two-rowed Prize Prolific next year."

LAMBTON.

Arthur Vance, Bosanquet had 70 bushels from 2 bags sown and says "It yielded about 5 bushels per acre more than Canadian barley. I mean to try it again next year."

Thomas Bowman, Mandaumin, had a total yield of 27 bushels, or 25 bushels per acre. He says: "It looked well until the heavy rains came; then it began to change."

George Forbes, Kertch, had 30 bushels in all. He says: "Yield would have been much larger, if I had sown thinner. It stooled wonderfully; 1 bushel per acre would have been plenty."

George Lucas, Lucas, had 35 bushels per acre. He says: "Being late in sowing, decreased the yield."

HALDIMAND.

Thomas Harris, Hagersville, had 23 bushels, or 22 bushels per acre. He says: "Six-rowed barley in the same field averaged 20 bushels per acre."

William Chambers, of Jarvis, had 24 bushels. He says: "The yield has been much better than the six-rowed, which has not been more than 15 bushels; season unfavourable."

Thomas Berry, Tyneside, had 22 bushels per acre. He says: "This barley yielded nearly twice as much as my other barley did. I intend to sow 10 or 11 acres next spring."

Walter Jones, Garnet, had 20 bushels per acre. He says: "I had six-rowed barley in the same field. It didn't yield over 16 bushels."

PETERBOROUGH.

E. Hawthorne, Warsaw, had a yield of 25 bushels per acre. He says: "It yielded better than any six-rowed I have seen threshed in this neighbourhood." John Buckham, Beresford, had a yield of 36

bushels, 25 bushels per acre and says : "It has been a poor season for barley in this section, the common six-rowed not yielding so well as the two-rowed has done with me."

Chas. Nicoll, Norwood Station, had 38 bushels from one bag sown; Wm. Stewart, Peterboro, a total yield of 35 bushels, 28 bushels per acre.

F. Birdsall, of Birdsall's, sowed four bags on 5 acres; yield, 30 bushels to the acre. He says: "In several places in this neighborhood it has turned out better than the six-rowed."

Geo. A. Grover, Norwood, had 31 bushels, or 26 bushels per acre. He says: "A poor year for barley; the six-rowed did not yield 10 bushels per acre on same soil, this is the best crop on the whole farm in bulk and if a price is once established will be profitable."

C. Stirton, Bensfort, had 42 bushels from one bag of seed, or 34 bushels per acre. He says: "Weather wet and unfavourable, it did not ripen very evenly, I intend to try a few acres of it next season."

A. Scott, of Peterboro, had 30 bushels per acre, L. Hunter, Lakefield, 24 bushels per acre, and E. M. Sanderson, Springville, 29 bushels. He says: "I think my barley has done very well, as it was a very poor season."

HALTON.

Andrew Elliot, Kelso, had 38 bushels from one bag sown on 1 acre. He says: "I am very much pleased with the result, and have no doubt if a market can be had for it the six-rowed will soon be displaced." Mr. Elliot's sample weighed 54½ lbs. per bushel.

Wm. Patterson, Milton, had 40 bushels from one bag on 1 acre. He says: "The six-rowed only yielded 20 bushels to the acre. I intend sowing the two-rowed again next year."

Geo. Hume, Ashgrove, had 32 bushels from one bag sown. He says: "It grew very rank, and part of it lodged before it headed, but for this the sample would be better."

Wm. Cline, Nelson, had over 40 bushels from one bag, which weighed 54 lbs. per bushel.

John Alexander, Tansley, a yield of 40 bushels, 25 bushels per acre.

Thos. Cameron, Acton West, had 30 bushels per acre. He says: "I sowed too thick; 1¼ bushels to the acre is plenty."

Wm. D. Johnston, Esquesing, had 26 bushels per acre; and M. Dice, Milton, a total yield of 30 bushels, or 24 bushels per acre. Mr. Dice says: I am well pleased with the result of this season's crop."

WENTWORTH.

John Marshall, Hamilton, had 27 bushels per acre. He says: "This was sown on same day as our Canadian barley, and in the same field; Canadian barley went 20 bushels to the acre."

Robert Armes, Glenford, had 36 bushels per acre. He says: "I sowed the bag on 1 acre, but it was too thick. Had it been thinner I am satisfied I should have had 10 or 12 bushels more. I am satisfied with the turnout I got from the 2 bushels. My six-rowed turned out 36 bushels per acre, but I put it on good ground that was in hoed crop the year before. The general turnout of six-rowed here has been 20 bushels."

John A. Bruce, of Hamilton, had 618 bushels from 24 acres, or over 25½ bushels to the acre, says: "Sowed 2nd May, on sandy loam with some clay; harvested 5th August. The soil would not be termed good barley land: had been worked for 20 years in growing vegetables and seeds. Considering the season and conditions of soil, the results were fairly satisfactory. The yield per acre and weight of grain place the two-rowed as the largest crop in this locality." The sample sent by Mr. Bruce weighed 52½ lbs. per bushel.

John Marshall, Barton Township, had 27 measured bushels. Says: "Weight, 52 lbs. to bushel. It was sown on the poorest part of the farm, to give it a fair trial. Two bushels of six-rowed were sown alongside and produced 20 bushels, weight 49 lbs. to bushel."

Mr. G. E. Tuckett, of Hamilton, had 334 bushels from 10 bags of seed sown on 10 acres of land equal to $33\frac{4}{10}$ bushels per acre.

A. Marshall, North Glanford, had 30 bushels per acre.

E. Blagdon, East Flamboro' a total yield of 40 bushels or 20 bushels per acre; E. Dyment, Dundas, 32 bushels per acre.

CARDWELL.

Wm. Campbell, Mono Mills, had 45 bushels per acre and says: "I intend to sow a considerable quantity next spring."

James Burke, Fintona, had a total yield of 45 bushels, 38 to 40 bushels per acre. Robert Burke, of the same place, a yield of 45

bushels, 40 bushels per acre. Jacob Cunningham, Mono Road, 35 bushels or 30 bushels per acre. Robert Murphy, Arlington, had 35 bushels from one bag sown on 1½ acres. Says: "Straw did not stand up like Canadian six-rowed; all barley was far below the average this year. Will try two-rowed again another season."

Mr. H. Harris, Caledon, had 28 bushels from one bag sown on one acre, says: "It was sown too thick. Next year I mean to sow 1¼ bushels per acre." Hugh Wilson, Mono Road, had a total yield of about 35 bushels and says: "I think it will do well," and Thos. Wilson, Mono Road, 40 bushels. Wm. Lindsay of the same place had 30 bushels. He says: "The barley arrived about ten days too late to have a fair trial, but yielded about five bushels more per acre than the six-rowed. John McKim, Caledon, had 30 bushels per acre, and says: "The two-rowed was the best we had."

LEEDS.

Wm. Dunn, Sweet's Corners, had a total yield of 35 bushels, and says: "The season was too wet; we are well suited with the grain and think it will do well here."

John E. Stacey, Lansdowne, had a yield of 19 bushels or 15 bushels to the acre, and says: "The whole crop was injured by excessive rains, this was 75 per cent. ahead of the six-rowed barley."

Having now reached those counties which have had an average of less than 8,000 acres in barley for the past eight years and where but little barley is raised for export fewer details will be given.

CARLETON.

Wm. Mansfield, Manotick, had a total yield of 30 bushels, 23 bushels per acre, he says: "Compares favourably with six-rowed." James Craig, North Gower, had 28 bushels per acre, says: "The barley grew stronger than the six-rowed and stood up much better."

DUNDAS.

Duncan McDonald, Ormond, had a total yield of 30 bushels or 20 bushels to the acre, and says: "The exceedingly wet season was unfavourable."

KENT.

Alex. Pick, Williams, reports the yield per acre at 30 bushels by guess, and says: "Not yet measured, crop lodged badly, sowed too heavy." Geo. Cook, Chatham, had a total yield of 50 bushels, or 40 bushels per acre.

NORFOLK.

G. H. Chrysler, Port Dover, had a yield of 38 bushels, or 26 bushels per acre, and says: "Six-rowed barley almost an utter failure in this locality, yielding only 10 or 12 bushels to the acre, am well pleased with the Prize Prolific." H. C. Hagarth, Culloden, had 31 bushels, or 25 bushels per acre. W. H. Teeter, Teetersville, 84 bushels from two bags sown on three acres, or 28 bushels per acre. O. Ansley reports a total yield of 50 bushels, or 25 bushels per acre, and C. A. Dunkin, of Victoria, between 24 and 25 bushels to the acre. Mr. Dunkin says: "I am well satisfied with the barley and expect to sow a number of acres of it in the spring."

ELGIN.

John Edkins, Union, had 36 bushels, he says: "Our land was poor and unfit for barley, but I determined to try it first on poor land; am pleased to say it gave me the greatest satisfaction. There was not as good a piece of barley of any kind in this part of the township." David J. Watson, Fingal, had 25 bushels per acre, He says: "Was sown three weeks later than my own and the yield was five bushels more."

LINCOLN.

Isaac Tufford, Beamsville, had a total yield of 30 bushels, about 30 bushels to the acre. Says: "I have no doubt the barley would do well here with a favourable season."

Thos. R. Merritt, St. Catharines, sowed 9 bags on 10 acres and had 254 bushels, a little over 25 bushels per acre. He says: "Sown April 30, harvested July 31, should have been sown early in April; the ground was ready but the seed did not come in time for early sowing."

W. W. Claus, Jordan, had a total yield of 35 bushels, or 28 bushels per acre.

LANARK.

B. W. Dunnett, Pakenham, had 75 bushels from two bags sown, or 25 bushels per acre. Says: "Takes two weeks longer than six-rowed; does well on clay land."

ESSEX.

Alex. St. Louis, Walkerville, had 25 bushels per acre, He says: "Sown May 5, harvested August 10. I got mine about one month too late, if I had sown it about the last of March it would have been much better."

STORMONT.

J. R. Crysler, of Crysler, had a total yield of 36 bushels, or about 34 bushels to the acre.

GLENGARRY.

D. R. McLennan, Lancaster, had 35 bushels per acre, He says: "I think the barley is very good, I only sowed one acre this year.

RENFREW.

Jas. Carney, Pembroke, had a yield of 26 bushels from $\frac{3}{4}$ of an acre, or over 34 bushels to the acre. He says: "Sown 5th June, harvested 10th September. This was sown late and stooled well, but the season was unfavourable." This grain when cleaned weighed $51\frac{1}{2}$ pounds per bushel.

SUMMARY.

In the summary which has been presented, the experience of 320 farmers in Ontario has been given, covering, I believe, every district where the two-rowed barley has been grown. This list might have been greatly increased with similar testimony equally good, but enough has been given to show that there is not much fault to be found with the barley. A proportion of the reports are less favourable than some of those which have been given, but in most instances these may be attributed to a very wet season, lack of drainage, or want of care in the preparation of the land. Many think that the straw is a little weak, but a very wet season does not afford a good opportunity for correct judgment on this point. There is no doubt that two-rowed barley takes a longer time to mature than the six-rowed, and that it should be sown early.

It is scarcely necessary to refer here in like detail to the results obtained in the other Provinces, as the number of returns is relatively small and a correct general idea can be got by consulting the table of averages.

GERMINATING POWER OF CANADIAN GROWN TWO-ROWED BARLEY.

It has been stated that the two-rowed barley grown in this country deteriorates so rapidly as to become deficient in vitality. To test the validity of this statement the germinating power of 685 samples of last year's growth in Ontario has been determined, and the average is $94\frac{1}{2}$ per cent.; 29 samples from Quebec averaged 92 per cent.; 17 from New Brunswick $87\frac{1}{2}$ per cent.; 7 from Prince

Edward Island $96\frac{1}{2}$ per cent.; 27 from Manitoba 88 per cent.; and 13 from the North-West Territories $88\frac{3}{4}$ per cent., making a total of 778 samples tested. These were all samples of the Prize Prolific barley sent by farmers who had obtained the seed from the Government importation. These figures require no comment, and the objection referred to falls to the ground.

MARKETS.

With regard to a market, there seems no doubt that Great Britain can take all the surplus that Canada will want to export, and the price paid for it will depend on the quality of the article. It is the opinion of the largest dealers in Canadian barley in Ontario that the six-rowed barley, during the past season, has been at least two pounds lighter than the average of past years. If this be so, it is reasonable to suppose that the same influences have affected the two-rowed barley in similar degree. An average of two pounds in weight added to such two-rowed barley as was grown the past season, would bring a very large proportion of it up to a standard of quality which would command remunerative prices in the British markets. Judging from the valuations of the samples sent to England last year, which were published in Bulletin 7, there is every reason to hope for profitable returns from this trade. The comments of the judges, at the recent Brewers Exhibition in London, England, who examined the samples of Canadian grown two-rowed barley shown there, give evidence that favourable opinions have been formed regarding Canadian barley, even where the weight has not exceeded 52 pounds per bushel. Many enquiries have been made of late for consignments of Canadian two-rowed barley for the English market, but no sufficient quantity has been available this season for the purpose. Fifty quarters or 400 English bushels of the two-rowed of last season's growth, weighing about 52 pounds per bushel, were procured and this barley has been forwarded to England to have its market value determined, also its quality for malting and brewing. Another lot of 320 bushels of similar quality has been secured for a comparative brewing test in Canada. As soon as these tests are completed and the information which is sought available, the results will be promptly given to the public. It is not to be expected that two-rowed barley of *prime* quality can be grown in all parts of Canada; this cannot be done in England or Scotland, where some districts produce much finer

samples than others. But in those localities less favourable for producing fine malting barley the two-rowed varieties will be profitable to grow for feed, as the experience gained seems to show that they are more prolific than the six-rowed sorts. In preparing barley for market it should be thoroughly cleaned, and all the light grain separated. The separating of 10 or 15 per cent. of the poorer grain adds much to the value of the better barley remaining, and the screenings can be used with profit at home as food for stock.

BARLEY CULTURE.

I desire to refer once more to the importance of early seeding and of a thorough preparation of the soil before sowing. The figures given in the early pages of this Bulletin on the results of the tests of the past season show in the increase of crop the advantage of sowing barley after roots, but where this is not practicable a good mellow piece of ground should be selected, one that has been well worked and is in fair condition as to fertility. This crop will not give good returns when sown on cold, wet ground, or on land that has been too much impoverished by frequent cropping and scanty manuring. The roots of the young barley plant make rapid growth under favourable conditions, but they do not strike so deeply in search of food as those of some other cereals; hence, the nutritive elements they need should be presented to them in the soil in such a well digested condition as to admit of its being readily taken up by the growing rootlets. A little experience will no doubt enable our intelligent Canadian farmers to obtain in favourable localities and average seasons good results from this promising crop.

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CENTRAL EXPERIMENTAL FARM.

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DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - CANADA.

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BULLETIN No. 10.

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Treatment of Apple Scab, Grape and Gooseberry Mildew.

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APRIL, 1891.

To the Honourable

The Minister of Agriculture.

SIR,—I beg to submit for your approval the tenth bulletin of the Central Experimental Farm, which has been prepared under my direction by Mr. John Craig, Horticulturist of the Central Experimental Farm.

The alarming spread of fungoid diseases on fruits during the past few years, and the serious losses resulting therefrom have awakened much interest in this subject among fruit growers, both in Canada and the United States. The simple and practical remedies recommended in this bulletin for several of the most troublesome of these parasitic growths, based on experience, both at the Department of Agriculture in Washington and at the Experimental Farm in Ottawa will, I trust, be thoroughly tested by those engaged in the cultivation of the apple, grape and gooseberry, and, if used in accordance with the directions given, there is every reason to believe that the treatment will be successful.

I have the honour to be

Your obedient servant,

WM. SAUNDERS,

Director Experimental Farms.

OTTAWA, 25th April, 1891.

TREATMENT

OF

Apple Scab, Grape and Gooseberry Mildew,

BY

JOHN CRAIG,

Horticulturist of the Central Experimental Farm.

The spread and development of the disease, known as "apple scab" and "black spot" of the apple (*Fusicladium dendriticum Fckl*), has been so gradual, during the past ten or fifteen years, that orchardists do not at the present time fully grasp the magnitude of the annual loss from this cause to the fruit interests of the Dominion. While the prevalence of the malady is not always constant in the same locality, yet it is spreading each year and extending its ravages to varieties hitherto unaffected. It is true that many varieties are comparatively exempt, yet we cannot expect "fungous proof apples," except in a relative degree.

This disease is not of recent introduction, nor is it confined to America alone. It is severest in the northern and cooler regions; but as it is in these districts that the bulk of our apples is produced, it becomes the more important that orchardists and fruit-growers should look closely into the subject of suitable remedies.

Many orchards of Fameuse that ten years ago yielded 60 to 75 per cent. of first-class apples do not now give more than 25 or 30 per cent., and the remainder "seconds" or "thirds."

The late Mr. Charles Gibb* stated to the Montreal Horticultural Society that in his orchard, which was more completely exposed to the prevailing winds, and in which the disease was more pronounced than in any other orchard in that locality, the effect was so marked that his apples brought an average of only 25 cents per bushel, or

*Report of Montreal Horticultural Society, 1886-87, page 21.

62 cents per barrel. If free from spot the same variety would have sold readily for 75 cents per bushel. Out of 15 barrels he had:—

First-class	....	0 bbls.
Second-class	....	1 "
Third "	....	4 "
Fourth "	....	10 "

The reduction in value in the selling price is only one side of the question. When the loss resulting from diminished size is considered it fully equals the first source of loss, making a total direct and indirect depreciation of value, which, when compared with first-class fruit, would stand as about 1 to 4.

The importance of gaining a practical knowledge of the habits of this fungus is manifest, and it is a matter of immediate and vital interest to all fruit-growers to know that a treatment which promises to be entirely successful has been discovered, and is already being used to a considerable extent.

CAUSE OF APPLE SCAB.

The apple scab is caused by a minute parasitic fungus, a low form of plant life, which, by living on the leaf and fruit of the apple, prevents assimilation in the former and the development of the latter. It is not so generally known that the same fungus attacks both the leaves and the fruit. Prof. Scribner * says: "On the leaves the first manifestations of the presence of the parasite are the appearance here and there over the surface, of smoky olive green spots, rounded in outline. The older spots range from one-eighth to one-half an inch in diameter, or they may appear as large irregular blotches, by the running together of several of the spots first formed. They are for the most part confined to the upper side of the leaf, which often becomes much distorted through the unequal development of the two surfaces. The colour of the older spots is nearly black and their surface somewhat velvety. The growth of the young shoots is often seriously checked through the direct action of the fungus upon them, and when the foliage of a tree is much affected its nutrition must be seriously impaired. The tree is rendered less liable to withstand the severe cold of the winter season, and is rendered more likely to injury from early and late frosts." Cool damp weather is especially favourable to the develop-

* Scribner, Fungous Diseases.

ment of this disease, and it is during such seasons that it spreads with great rapidity. Last season was a characteristic one in this respect, so that whether the coming summer be dry or wet it may be expected that with the crop of seed, (spores) now on hand we must be prepared to fight the disease, as it will surely be more or less prevalent.

The appearance of the scab on the apple is too well known to need a minute description. When a thin section of the diseased portion of the fruit is examined by the aid of a microscope, Prof. Galloway* says that "a cluster of short brownish threads is seen arising from a darker mass of roundish cells, which are seated directly upon the healthy tissue of the fruit or the leaf, as the case may be. The free ends of the threads often bear pear-shaped bodies of nearly the same colour as the supporting threads. The pear-shaped bodies are the spores of the fungus, and it is through their agency that the parasite is propagated. The brownish threads serve merely as supports for the spores, while the dark mass of tissue constitutes the body of the fungus, or, if I may so express it, the root, branches and leaves. When full grown the spores separate readily from their supporting stalks, and being exceedingly light, are easily wafted from place to place by currents of air. In this way they reach healthy fruit and leaves, and if the proper conditions of moisture and heat are present they quickly germinate, by sending out slender tubes, which bore their way into the leaves or fruit, and ultimately give rise, just beneath the cuticle or skin, to dark masses of cells, like those already described. At first this mass of fungous tissue is entirely beneath the cuticle, but as the former continues to grow the latter is ruptured, and it is then that another crop of stalks and spores are formed. In this way the fungus continues its development throughout the growing season, the crops of spores formed in the autumn living over winter on the old leaves, fruit and young branches." And thus we have a stock of seed (spores) for next year's crop, which germinate, as already stated, when favourable conditions are found. Just as soon as the leaves begin to form in the spring they are attacked by the disease, and what is true of the leaves is also true of the fruit, spots being sometimes noticeable on the latter when little larger than peas. This emphasizes the statement that early treatment is a prime essential towards successful results.

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* Galloway, Bulletin 59, Mich. Experiment Station.

REMEDIES.

During the past two years experiments have been in progress under guidance of the Division of Mycology, Department of Agriculture, at Washington, the Experiment Stations of Wisconsin and Michigan. Trials were made at these places with certain chemical preparations, applied in the form of a spray—in the same manner that Paris green is used to check the ravages of the codlin moth. Beneficial results were obtained by the use of several compounds, but that known as "ammoniacal solution of copper carbonate" has in nearly every instance given the most encouraging returns. Professor Goff,* of the Wisconsin Agricultural Experiment Station, obtained by the use of this fungicide, when applied to apple trees of the Fameuse variety, the following results :—

——	Per cent. in Fruit, First Quality.	Per cent. in Second Quality.	Per cent. in Third Quality.
Sprayed	75·02	23·35	1·63
Unsprayed	23·34	53 89	22·71

Professor Goff used $1\frac{1}{8}$ oz. carbonate of copper, dissolved in 1 quart of ammonia, diluted with 22 gallons of water.

Professor Taft,† of the Michigan Agricultural Experiment Station, obtained results as follows, by the use of the same substance in the following proportions :—3 oz. carbonate of copper dissolved in 1 quart of ammonia and diluted with 22 gallons of water :—

——	Per cent. Free from Spot.	Per cent. Slightly Spotted.	Per cent. Badly Spotted.
Sprayed..................	51·2	48·6	0·6
Unsprayed..................	12·5	85·7	1·8

These results are very striking, and are worthy of careful consideration.

*Bulletin No. 23, Wisconsin Agricultural Experiment Station.

†Bulletin 59, Michigan Agricultural Experiment Station.

Experiments conducted last year.

It was in consideration of the above results that a series of experiments along this line were conducted at Abbotsford, Que., during the past season, on the farm of Wm. Craig & Son. I am indebted to Mr. Wm. Craig, jr., for his labour in superintending the work, and furnishing me with some of the facts upon which the following deductions are based.

I am also indebted to Mr. F. T. Shutt, Chemist to the Experimental Farms, for valuable assistance in planning the lines of experiments, and for the preparation of the copper carbonate and other necessary materials.

The trees selected were of the Fameuse variety, planted fourteen years ago on a loose, gravelly soil. During the past four years this orchard has not yielded more than 25, and often not even 10 per cent. of first-class apples.

Five rows in the centre of this orchard were selected, each row, which contained fourteen trees, being treated with a different mixture. A row of trees untreated was allowed to remain on either side of those operated upon. Four applications were made, one on each of the following dates: 14th and 26th June, and 17th and 29th July. At the time of the first application the fruit was about the size of garden peas.

When the fruit was picked it was divided into three grades, numbered, according to quality, first, second and third. The results are given in this way:—

Row 1.—Treated with

Copper carbonate	1½ oz.
Ammonia	1 qt.
Water	22 gals.

Result:

	Per cent.
First quality	33
Second do	25
Third do	42

Row 2.—Treated with

Copper carbonate	3 oz.
Water	22 gals

Result:

	Per cent.
First quality	50
Second do	25
Third do	25

Row 3.—Treated with

Copper sulphate	1 lb.
Ammonia	1½ pts.
Water	22 gals.

This solution was too strong, injuring the leaves to such an extent as to cause half of them to drop within ten days from date of application. A second and weaker application had the same effect.

Row 4.—Treated with

Copper sulphate	1 lb.
Water	22 gals.

This had practically the same effect as the above, and was discontinued after a second application. It would seem with this result before us, that the ammonia did not increase the injurious effect of the copper sulphate.

Row 5.—Treated with

Hyposulphite of soda	1 lb.
Water	22 gals.

No beneficial effect was noted, though the experiments on this row were rendered useless by severe inroads of the leaf-crumpler.

Row 6.—Untreated.

	Per cent.
First quality	24
Second do	26
Third do	50

The time occupied in making each application, covering the 70 trees, was about 3½ hours with one man and boy and a horse. Of course, if the same mixture were used on the whole lot without any change, the time taken in making the application would be greatly reduced. As the cost of the application is much increased by the addition of ammonia in the copper carbonate mixture—while the results in the experiments cited above do not seem to warrant its use—it would appear that the copper carbonate and water mixture

in the strength as applied above could be used to advantage, and at a cost of about 1 cent per tree each application, or 5 cents for the season. This is an outside estimate even for large trees.

It is noteworthy to mention a fact which has attracted the attention of other investigators, viz., that the older leaves seem to be more sensitive to injury from most fungicides and insecticides, than the young and growing leaves. The later applications emphasized this observation.

The beginning of the work was unavoidably delayed until 14th June when the fruit was well formed, and in many cases had begun to show signs of the disease. There is no doubt had the treatment been commenced two or three weeks earlier the results would have been more favourable.

The most important point brought out in this work is that in connection with the use of the carbonate of copper in simple mixture or suspension with water.

This has been tried but one year, yet the results are sufficiently marked to lead me to ask that each fruit-grower who takes up this work should make a special test on at least a few trees, using the *carbonate* of *copper in suspension.*

Fungicides recommended.

The following mixtures are recommended :—

1. Ammoniacal copper carbonate—

Carbonate of copper........................	8 oz.
Ammonia	1 gal.
Water.	100 gals.

How to Prepare.

In an ordinary vessel capable of holding a gallon or more, put 2 ounces of carbonate of copper and 1 quart of ammonia (ask your druggist for *strong ammonia*) ; when the copper is completely dissolved pour the mixture into a barrel and add 25 gallons of water. The solution is then ready for use.

Medium sized trees will take about 1 gallon each, and large trees from 1 to 2 gallons. A convenient method when using this formula is to prepare the carbonate of copper by dissolving it in the ammonia at once in the full quantity ordered above, and keeping it ready for use stored away in ordinary quart glass jars ; these to be diluted with water as needed.

2. Carbonate of copper in suspension—

Carbonate of copper	2 oz.
Water	25 galls.

This is prepared for use in the same way as Paris green by mixing thoroughly with the water. A more evenly distributed mixture can be obtained by first stirring the carbonate of copper into one gallon of water, when well distributed this is poured into the remaining 24 gallons, and the whole thoroughly agitated. This mixture requires more care in application than the ammoniacal solution; it should be constantly agitated and laid on in a fine spray.

A COMBINED FUNGICIDE AND INSECTICIDE.

A series of experiments were conducted at the Central Farm last summer by the writer, assisted by Mr. Shutt, Chemist to the Experimental Farms, with a view to test the degree of strength which a combined fungicide and insecticide could be applied without injuring the leaves. The following are extracts from the summary of conclusions reached after several applications.

The quantities of chemicals given are on the basis of using 22 gallons of water, with ammonia as the solvent.

Carbonate of copper, 3 oz. in solution, Paris green, $1\frac{3}{4}$ oz. (proportion of 1 lb. to 200 galls. of water) caused a slight injury on the third application.

Carbonate of copper, $1\frac{1}{2}$ oz. in solution, Paris green, $1\frac{3}{4}$ oz. caused very slight injury after the third application.

Carbonate of copper, 3 oz. in suspension, Paris green, $1\frac{3}{4}$ oz. caused slight injury in later applications.

Carbonate of copper, $1\frac{1}{2}$ oz. in suspension, Paris green, $1\frac{3}{4}$ caused no injury.

RECOMMENDED FOR TRIAL.

In view of the above results I would therefore recommend for trial, to a limited extent, mixtures, as follows:—

(*a*.) Carbonate of copper	$1\frac{1}{2}$ oz.
Ammonia	$1\frac{1}{2}$ pints.
Water	25 galls.
Paris green	$1\frac{1}{2}$ oz.

The carbonate of copper should be dissolved in the ammonia, according to the directions already given, mixed with the water, and the Paris green then added, care being taken to stir in well, and keep it from settling to the bottom.

(*b*.)	Carbonate of copper........................	$1\frac{1}{2}$ oz.
	Paris green....................................	$1\frac{3}{4}$ oz.
	Water	25 galls.

The experiments made with this mixture thus far, do not warrant me in speaking positively in regard to its efficacy, but they show that no injury to the foliage resulted from the application of a stronger mixture than the one here recommended for trial. If this proves an effective remedy for the codlin moth as well as the "apple spot" it will no doubt supersede any other now in use, both on account of the ease with which it can be prepared, as well as its comparative cheapness. The Paris green can be omitted after the second application in mixtures (*a*) and (*b*), as two sprayings of Paris green is generally considered a sufficient remedy for the codlin moth.

HOME MANUFACTURE OF COPPER CARBONATE.

As the precipitated form of carbonate of copper is not always obtainable from druggists, directions are herewith appended for the easy preparation of this material at a cost much less than the usual wholesale price.

In a vessel capable of holding two or three gallons, dissolve $1\frac{1}{2}$ pounds of copper sulphate (blue vitriol) in 2 quarts of hot water. This will be entirely dissolved in fifteen or twenty minutes, using the crystalline form. In another vessel dissolve $1\frac{3}{4}$ pounds of sal soda (washing soda) also in 2 quarts of hot water. When completely dissolved pour the second solution into the first, stirring briskly. When effervescence has ceased fill the vessel with water and stir thoroughly; then allow it to stand five or six hours, when the sediment will have settled to the bottom. Pour off the clear liquid without disturbing the precipitate, fill with water again and stir as before; then allow it to stand until the sediment has settled again, which will take place in a few hours. Pour the clear liquid off carefully as before, and the residue is *carbonate* of *copper*. Using the above quantities of copper sulphate and sal soda, there will be formed 12 ounces of copper carbonate.

Instead of drying this, which is a tedious operation, add four quarts of strong ammonia, stirring in well, then add sufficient water

to bring the whole quantity up to 6 quarts. This can be kept in an ordinary two gallon stone jar which should be closely corked.

FORMULA.

Each quart will contain 2 ounces of the carbonate of copper, which when added to 25 gallons of water, will furnish a solution for spraying, of the same strength and character as that obtained, by the use of the dried carbonate, and one which can be prepared with little labor, and kept ready for use throughout the season.

CARBONATE OF COPPER IN SUSPENSION.

When the carbonate is to be used in suspension, instead of adding the ammonia to the sediment, add water until the whole quantity is made up to 6 quarts. Stir this thoroughly until the sediment is completely suspended (entirely mixed throughout) and pour the thick liquid into a suitable jar, when it will be ready for use.

Before using shake the contents thoroughly, so that all the sediment may be evenly distributed in the water. Pour out a quart of the thick fluid and mix with 25 gallons of water.

The cost of the chemicals will vary with the amount purchased Copper Sulphate (blue vitriol) is usually retailed at from 10 to 12 cts. per pound, and Sal Soda (washing soda) at about 3 cts. per pound. The strong ammonia should be used which can be bought in half gallon jars at from 20 to 25 cents per pint.

WHEN TO SPRAY.

The importance of early treatment cannot be too strongly urged, as after the disease has gained foothold and is working within the tissues, remedies which can only be applied externally are of very little use. The first application should be made *before the blossoms open;* the second soon after they have fallen, the third and fourth following in periods of about ten days or two weeks apart. If the season is cool and wet, a fifth application will be necessary, but if moderately dry, four applications, if begun in good time, will in all probability be sufficiently effective.

HOW TO APPLY THE FUNGICIDE.

1. For orchard work use some form of a barrel pump.
2. Use nozzles which will distribute the liquid in a fine misty spray.

3. The trees do not need to be drenched, but must be completely moistened with the mixture.

4. Reliable pumps are manufactured by the Field Force Pump Co., Lockport, N.Y., Gould Manufacturing Co., and Rumsey & Co., both of Seneca, N.Y., and the Nixon Nozzle and Machine Co. of Dayton, Ohio.

I am not aware that these pumps are manufactured in Canada.

MILDEW OF THE GRAPE.

The disease particularly referred to in the following is known among viticulturists as "downy mildew," "brown" or "gray rot" of the grape, and to scientists as *Peronospora viticola*, was very severe last year in many grape growing districts. It has been particularly destructive in the Eastern and Central States, and also in Western Ontario. Last year it was prevalent in vineyards in the Province of Quebec, and also in the Ottawa Valley.

As a rule it is first noticed on the fruit—when about half formed—presenting a downy and frosted appearance, which gives place to a grayish brown in the later stages. The berries shrivel and fall to the ground when slightly shaken. Beginning with one or two varieties in the vineyard, the disease if allowed to run its course will spread rapidly, attacking other kinds which were at first entirely exempt.

It usually affects the leaves and wood later in the season, sometimes in the case of early varieties after the fruit has been gathered. This stage of the disease was prominent as affecting the Roger Hybrids in the Experimental Farm vineyard last season.

At first it is seen on the upper surface of the leaf showing in brown spots, while the lower surface presents the frosted appearance resembling that form of the disease affecting the fruit. This particular leaf form is not easily detected on grapes having the thick pubescent leaves characteristic of the Concord family.

TREATMENT.

Carbonate of copper............................	2 oz.
Ammonia..	1½ pint.
Water..	25 gals.

As soon as the mildew made its appearance last year on our vines they were thoroughtly sprayed with the above mixture. Two applications and the removal of all diseased berries had the effect of checking the spread of the malady, but at the same time demonstrated—when compared with the results of my former experiments—that the proper line of treatment leading to complete success, lies in the *early application* ot the remedy.

The following is the course of treatment planned for the vineyard of the Experimental Farm this season:

1. All prunings, leaves, etc., to be carfully burned.

2. When vines are uncovered spray them—including the posts and trellises—with a simple solution of copper sulphate (blue vitriol) 1 ℔, dissolved in 15 gallons of water.

3. Spray with the ammoniacal copper carbonate using the formula already given soon after the fruits sets; make two or three additional applications at intervals of ten days or two weeks as the necessities of the case seem to demand.

4. Remove and destroy diseased parts of the fruit and foliage.

GOOSEBERRY MILDEW.

The great draw back to the successful cultivation of the European goosebery in Canada has been the annual loss occasioned by the prevalence of this disease (*Sphærotheca mors-uvae* B. & C.) The external appearance of the fungus is well known, showing on the young woods, leaves and fruit as a whitish downy coating, usually appearing soon after the leaves have fully expanded.

TREATMENT.

Successful results are reported by Prof. Goff of the Agricultural Experiment Station of Wisconsin, by the use of Potassium Sulphide (liver of sulphur) at the rate of 1 ounce dissolved in four gallons of water. Spraying was commenced when the leaves were partly expanded, and repeated seven or eight times during the summer.

Without actual experiment it would not be wise to recommand the unrestricted use of any remedy for this disease, but from our present knowledge of the general efficacy of the ammoniacal copper carbonate, it seems safe to advise a trial at any rate, of this remedy in the same proportions as those given for the apple and grape.

The effect on the foliage of the first application should be carefully noted, and if at all injurious the amount of copper carbonate, should be lessened to $1\frac{1}{2}$ ounces.

A REQUEST.

All persons who are interested in, and take up any of these lines of experiment are earnestly requested to forward me as soon as practicable the results of their work, together with such notes explanatory of the conditions affecting the trials, as shall aid me in forming correct conclusions in regard to the value of these remedies.

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CENTRAL EXPERIMENTAL FARM.

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DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - CANADA.

——:o:——

BULLETIN No. 11.

——:o:——

Recommendations for the Prevention of Damage by some Common Insects of the Farm, the Orchard and the Garden.

——:o:——

MAY, 1891.

To the Honourable

The Minister of Agriculture.

Sir,—I have the honour to submit to you herewith Bulletin 11 of the Central Experimental Farm, which has been prepared under my direction by Mr. James Fletcher the Entomologist and Botanist of the Dominion Experimental Farms. The injuries caused by insects fall heavily on both the farmer and fruit-grower, and seriously reduce the profits arising from their labour. Much of this loss may be prevented by carrying out the recommendations given in this Bulletin. The concise accounts of the life-history of the injurious insects treated of, together with the illustrations, will enable the reader to readily distinguish the species referred to, and as the season is now approaching when these foes are most active, it is hoped that this timely warning may be heeded. The remedies suggested are easy of application, can be supplied at small cost, and I believe, if generally used, will result in much benefit.

I have the honour to be,

Your obedient servant,

Wm. SAUNDERS,
Director Experimental Farms.

Ottawa, 15th May, 1891.

RECOMMENDATIONS

FOR THE

PREVENTION OF DAMAGE BY SOME COMMON INSECTS

OF THE

FARM, THE ORCHARD AND THE GARDEN,

BY

JAMES FLETCHER,

Entomologist and Botanist to Dominion Experimental Farms.

The frequent enquiries for information concerning even the commonest and most injurious enemies of cultivated crops and fruits render it advisable to issue, in concise form for reference, an account of some of the more important of these, together with approved remedies and convenient methods of applying the latter. The insects treated of are those which have been most frequently enquired about by my correspondents during the last two seasons. Where possible, illustrations are given, so that those concerned may not only know the latest remedies, but at the same time may become familiar with the appearance of their enemies.

Economic Entomology is the name given to a special study of the habits of insects with the view of finding out and protecting such as are beneficial and of destroying those which are injurious.

As year by year larger areas of land are brought under cultivation the various injurious insects which attack special crops will become more and more numerous as the cultivation of their favourite food-plant is extended. It is estimated that there is no crop grown which is not diminished by an average of at least one-tenth, by the depredations of insect enemies, and this loss in some years runs up to one-

fourth or one-half of the whole crop. Of this loss there is no doubt that a large proportion can be saved by the adoption of simple methods founded on general principles, with which all can easily become acquainted. For the effective use of remedies to destroy injurious insects a certain amount of knowledge of their structure and habits is highly desirable, so that the most appropriate remedy may be adopted, and also that it may be used at the period when the enemy is most susceptible of injury.

The lives of insects are divided into four well marked periods. These are: 1. The egg; 2. The caterpillar or larval stage, during which, as a rule, they are most injurious; 3. The pupa or quiescent stage, in which, except in a few orders, they lie quiet, and are without the power of motion; and 4. The perfect insect. Some insects are injurious in three of their stages; but the larger number in one only, so that unless we try to know them in all their forms we may lose the best opportunities of destroying them. It is clear that in this warfare the one who possesses this information has a great advantage over those who do not.

Insects may be divided into two classes by the nature of their mouth parts. In the first or larger division, Biting Insects, they are furnished with mandibles or biting jaws, by means of which


Fig. 1.

they consume the substance of their food, as with caterpillars, beetles, etc. In the second class, Sucking Insects, they have instead of mandibles a beak or tube (Fig. 1), by means of which they suck up their food in a liquid form from beneath the surface, as with the true bugs, plant-lice and flies. It is evident that with the insects of the first class all that is necessary is to place some poisonous substance on the food plant, which they will eat together with their food. With the second class, however, this would be useless, for they would push their beaks through the poisonous covering on the outside of their food-plant and would extract the juices upon which they live from the interior. For this class, therefore, some substance must be used which will kill by mere contact with their bodies. Now, for both of these classes of insects we have cheap and available remedies, of which I will speak further on.

Remedies for injurious insects are either Preventive or Active, and must be applied in accordance with the circumstances of the case and the habits of the attacking insects.

PREVENTIVE REMEDIES.

These are of two kinds:—1. Agricultural; 2. Deterrent.

1. Agricultural.—These consist chiefly in the adoption of such agricultural methods as:—High Culture, which will stimulate a vigorous and healthy growth of the crop and push it on to maturity as soon as possible; Clean Farming, by which all weeds are kept down and rubbish is prevented from accumulating; Early or Late seeding, so that a crop liable to attack is presented to its enemies, at the time they make their appearance, in such a condition that they cannot injure it; Rotation of Crops, by which insects attracted to a locality by a certain crop will not have, in that place, the same crop to feed on the following year.

2. Deterrent.—Under this head come such operations as painting the trunks of fruit trees with poisonous, alkaline, or other obnoxious washes to keep out borers, by deterring the female insects from depositing their eggs upon the bark; the placing of mechanical contrivances on trees to prevent the ascent of insects, as climbing cut-worms, or the wingless female canker-worm moths, which leave the ground in autumn and spring and crawl up the trunks of trees to lay their eggs.

Destroying or masking the natural odour of some vegetables by scattering amongst them substances possessed of a stronger or disagreeable odour, as gas lime or carbolic acid.

ACTIVE REMEDIES.

Under this head comes the practising of such methods as may be called generally "hand-picking," or the seeking out of insects in their different stages and destroying them. These methods can be best explained under the several insects for which they are useful. The most important active remedies, however, comprise the application of the various insecticides or poisonous substances which are now so largely used for destroying insects, and which are treated of separately further on. Before passing on to a consideration of these it may be well to devote a few lines to the different methods and apparatus for applying insecticides.

APPARATUS.

Nearly all of the insecticides may be used both as a dry powder and as a wet mixture. In the case of the arsenical poisons it is necessary to mix them with some other substance as a diluent, on

account of their caustic action upon tender vegetation, also for convenience of distribution, and to economise the material in use. For dry applications suitable diluents will be found in flour, land-plaster, air-slaked lime, and finely sifted ashes or road-dust. It is of the utmost importance that these should be perfectly dry and in a very fine state of division, so as to mix thoroughly with the insecticide used and to allow of being distributed evenly over the plants as a very fine powder. The proper quantity of the diluents to be used with the different insecticides will vary with the insects to be treated and the plants to which they are applied.

There are several instruments for distributing dry poisons, such as bellows, insect-guns, dusting-boxes, etc. Any operation requiring the body to be kept for a long time in a stooping posture while walking soon becomes extremely tiresome. It is therefore necessary for field application to devise some means for distributing the poison, so as to waste as little as possible of the material and yet allow the body to be kept in its natural position. This is best done by placing the powder to be distributed in a small bag of very fine muslin (two thicknesses, if necessary), and then tying this to the end of a short stick so that it swings freely. It will be found that by tapping the bag lightly with another stick held in the other hand that the operator can walk erect, and do much better work than by stooping along over his crop with an aching back. Prof. Lintner recommends "a tin box of a convenient size (half a pint), with a cover, and having the bottom covered with wire gauze—the box to be fastened to a stick about three feet long. With this a person can walk along the plants to be dusted, and by gently striking the handle with another small stick the powder can be uniformly distributed with the greatest care." Dry mixtures should be applied when plants are wet with dew or in still weather. It is found by experience, however, that during the spring months, when insecticides are most needed, there are often periods of several days when these conditions do not occur. It therefore becomes necessary to apply the poisons in some other way, so that the material may be evenly distributed over the plants to be protected, and not blown away by the wind. For this purpose mixing with water and spraying is the most convenient plan, and there are a great many kinds of pumps and other appliances for the purpose. After considerable experience I have come to the conclusion that it will repay anyone who has to apply insecticides to go to the expense of

procuring a pair of proper bellows for dry mixtures and a force pump for liquid applications. Such make-shift contrivances as ordinary watering cans, whisks, whisps of hay, or bunches of leaves, which are frequently used, actually cost far more in wasted time and materials than would pay for the best special instruments; added to which, when the work is done it is neither satisfactory nor effective.

PUMPS AND OTHER DISTRIBUTORS.

For dry applications the "Woodason bellows," made by Thos. Woodason, 451 East Cambria street, Philadelphia, is one of the most highly recommended. It is made in two sizes, which sell at $1 and $2, respectively. The same firm also manufactures the "Woodason atomizer," for the application of a liquid spray upon a small scale. For more extensive operations force pumps of various sizes are necessary. These can be procured at prices ranging from $2 to $5 for small hand pumps. These are obtainable from most of our Canadian seedsmen. Very useful machines are the "Knapsack" sprayers, consisting of a tank of 4 or 5 gallons capacity, with a force-pump and spraying nozzle attached. They are carried on the back, and are very convenient for the treatment of low-growing crops, as cabbages, turnips, etc., as well as for small fruits. Of these the most highly spoken of are, the "Galloway Sprayer," manufactured by Albinson & Trusheim, 2026 Fourteenth street, Washington, D.C.: Cost, $14. Another machine which is highly approved is the Knapsack, manufactured by the Field Force-pump Co., of Lockport, N.Y., which sells for the same price. An excellent but more expensive machine is the "Eureka," made by Adam Weaber, Vineland, N.J.: Cost, $21. All of these are supplied with the "Vermorel" nozzle mentioned further on.

For field-work larger machines are necessary, and there are several in the market. The Field Force-pump Co. manufacture for $12 the "Perfection" pump which can be attached to a barrel. This pump has an extra discharge hose by which the poison is kept constantly stirred up in the barrel, a most important thing with Paris Green and London Purple mixtures. Gould's Manufacturing Co., of Seneca Falls, N.Y., also send out a machine which has given great satisfaction, called the "Standard Double-acting Spray Pump." This also may be fitted to the top or side of a barrel, and has two discharge tubes. It costs about $14 complete. The Nixon Nozzle and Machine

Co., of Dayton, Ohio, make two machines which are highly praised by all who have tried them. The larger the "Little Giant," consists of a square metal tank with force-pump, and is mounted on wheels. It can be drawn or pushed by means of a handle and driving wheel; but for use in an orchard the tank can be taken off the wheels and mounted in a waggon. Cost, $35. The same company also make a smaller machine, the "Climax Tripod No. 2," which sells for $15. It is very convenient, and can be taken apart and shipped in a very small box. It can be attached to any kind of vessel or tank by means of brass connections, which are supplied with it, as well as 20 feet of hose and 2 nozzles. I am so frequently asked where pumps and spraying apparatus are to be obtained that I have given the addresses of the above firms who have sent me their catalogues. A good pump, called the Orchard and Garden Force Pump, is made by W. Robertson, Oakville, Ont. I do not know of any other Canadian firms manufacturing these special forms of apparatus. Anyone intending to buy a spraying outfit would do well to send for catalogues before deciding on purchasing any particular machine, so as to procure the most suitable.

NOZZLES.

Of equal importance with a proper force-pump, in the distribution of poisonous applications, is a proper nozzle, by means of which the liquid is distributed evenly. Prof. Riley says "the desiderata in a spray nozzle are ready regulation of the volume to be thrown; greatest atomizing power with least tendency to clog; facility of cleansing, or ready separation of its component parts; cheapness; simplicity and adjustability to any angle."

There are a great many spraying nozzles in the market—some good, some decidedly otherwise. The best of these are the Riley or Cyclone, with its various modifications, and the Nixon. Prof. J. B. Smith says (Bul. 75, N. J. Ag. Col. Exper't. Station) :—"The Cyclone, with the 'Vermorel' modification for clearing the nozzle of obstructions, is the most widely applicable for spraying low plants and bushes, like cabbages, pumpkins, currants, blackberry and others. This projects a fine spray in an eddy from a central discharge orifice, and makes a perfect and, for a short distance, forcible spray. Fastened to a rod of convenient length, and set at an angle with the rod, all parts of the cabbage can be thoroughly wet in a few seconds. All who have ever used this nozzle are

delighted with it. It is manufactured by the Field Force-Pump Co., Lockport, N.Y."

The Nixon nozzle is equally valuable for a somewhat different range of work. The stream is projected through a small central nipple against a screen at the end of a brass cylinder, and is broken there into a fine spray, retaining considerable force. This is furnished by the Nixon Nozzle and Machine Co., and is an excellent nozzle for orchard use.

The question of elevating the spray, so as to reach the tops of trees, is merely one of attaching the discharge pipe of the pump to one end of a small brass or rubber tube, bearing the nozzle at the other end, and running it through (or lashing it to the side of) a bamboo or other light pole of the required length. A wedge-shaped washer, cut out of thick sole leather, placed just below the nozzle, will prevent the drip from trickling down the pole upon the operator.

REMEDIES.

For convenience of reference in the latter part of this Bulletin, I append a short statement concerning each of the best known remedies, which will be referred to by the numbers which precede them :—

I. *The Arsenites.*—The best known of these are Paris Green (Arsenite of copper) and London Purple, (chiefly Arsenite of lime). The former is in more general use in Canada, and from my own experience and that of my correspondents I consider it the safer of the two to use on vegetation. The latter, however, is highly praised by some who have used it, and it will probably be found more useful than Paris Green, on account of the lime it contains, for mixing with Bordeaux mixture and other fungicides for the combined treatment of insects and fungi. Paris green is a sure remedy for all mandibulate or biting insects ; but is also very poisonous to man and the domestic animals. Care must, therefore, be taken to keep it out of the reach of children, ignorant people and animals.

If applied too strong to the foliage of plants it is also very destructive. Some plants are much more easily injured by the arsenites than others, it therefore becomes necessary to use them with caution until the quantity that may be applied to a certain plant is known. For apple trees, a mixture containing ¼ lb. of Paris green to 50 gallons of water may be used ; for plums and cherries about the same strength ; but as some varieties are tenderer than others,

the effect of the application should be watched and the strength reduced if necessary. For peach trees it should not be used stronger than 1 lb. to 300 gallons of water, and even then there will be considerable risk of injury. Where it is necessary to spray two or three times in the season later applications of the poison should be reduced in strength.

In mixing Paris green it should first be made into a paste with a small quantity of warm water, and the paste subsequently mixed with the larger amount of water required.

In spraying foliage the spray must be forcibly applied, so as to reach every part; but should be shifted from place to place as soon as the liquid begins to drip from the leaves.

To lessen the corrosive injury of the arsenites, Prof. Riley advises the addition of a quart of common flour to every 12 gallons of water. He say (5th Rep., U. S., Entom. Com., p. 33): "The flour seems to keep the poison from taking effect on the leaf, preventing, to some extent, the corrosive injury which otherwise obtains when the poison is coarsely sprinkled or too strong."

The effects of Paris green, strange as it may seem, are often less severe upon young foliage than upon that which is mature. In applying liquid washes of Paris green and other insecticides it will be found difficult to make them adhere to some plants, such as cabbage, Swede turnips, etc. This difficulty can be overcome by mixing a little soap with the water used. For dry applications, Paris green may be mixed with 100 times its weight of perfectly dry land-plaster, air-slaked lime, flour or sifted wood ashes, etc.

II. *Kerosene Emulsions.*—Next in importance to the arsenites are the emulsions of kerosene. These are particularly valuable against such insects as plant-lice, scale insects and animal parasites. The best formula as recommended by Prof. Riley, is:

Kerosene (coal oil) 2 gallons.
Rain water, 1 gallon.
Soap, ½ lb.

Boil the soap in the water till all is dissolved; then, while boiling hot, turn it into the kerosene, and churn it constantly and forcibly with a syringe or force pump for five minutes, when it will be of a smooth, creamy nature. If the emulsion be perfect it will adhere to the surface of glass without oiliness. As it cools it thickens into a jelly-like mass. This gives the stock emulsion, which must be diluted with nine times its measure of warm water

before using on vegetation. The above quantity of 3 gallons of emulsion will make 30 gallons of wash. Insects breathe through small openings along their sides. The effect of kerosene emulsion is to suffocate them, by stopping up these breathing pores.

III. *White Hellebore.*—This is a vegetable poison—the finely powdered roots of *Veratrum album.* It is very useful for the leaf-eating insects of small fruits, especially saw-fly larvæ. Although very poisonous to insects, it can be safely used where the arsenites would be dangerous. It can be applied as a dry powder or as a liquid mixture, 1 oz. to 2 gallons of water.

IV. *Insect Powder,* (*Pyrethrum, Buhach.*)—This is another vegetable insecticide of special value, from the fact that although it is extremely active in its effects upon nearly all insects, it is practically harmless to human beings and the higher animals. It is the pulverised flowers of some plants belonging to the genus *Pyrethrum.* It is useful for many household pests, as flies, mosquitoes and wasps, all of which are quickly affected, either by having a small quantity thrown into the air of a room by means of an insect-gun or small bellows, or by a small quantity, (a teaspoonful,) being ignited and allowed to smoulder. It seems to have a marked effect upon the breathing organs of insects. Where practicable, a dry application gives the best results. If mixed with four times its weight of common flour, and then kept in a tightly closed vessel for twenty-four hours, the mixture will kill nearly all caterpillars it is applied to, and in this strength becomes the best remedy for the caterpillar of the Imported Cabbage Butterfly. It can also be used mixed with water, 1 oz. to 2 gallons of water.

V. *Alkaline Washes.*—A wash largely used in Canada is that noted by Prof. Saunders in his "Insects Injurious to Fruits," and consists of "soft soap reduced to the consistence of thick paint by the addition of a strong solution of washing soda in water. If applied during the morning of a warm day this will dry in a few hours, and form a tenacious coating not easily dissolved by rain."

Soap-suds made from whale-oil soap, 1 lb. to 8 gallons of water is a useful remedy for the destruction of plant lice.

VI. *Carbolic Acid.*—I have not found this substance so generally useful as I anticipated from its powerful odour. Prof. A. J. Cook, however, has experimented extensively with it and claims that no fruit-grower or lover of shade trees can afford to be ignorant of the Carbolic Acid Emulsion. He says: "I make it just as I do the

kerosene emulsion, only stronger, one part of carbolic acid—I use the crude material—to from 5 to 7 parts of the soap solution (1 quart soft soap, or 1 lb. hard soap, in 2 gallons of water) is of the proper strength. This is the best preparation I know of to protect against the apple-tree bark-lice and apple-tree borers."

It is applied to the trunks and larger limbs by means of a stiff brush or cloth about 20 days after the trees blossom.

Carbolic Acid Wash.—Prof. Cook also recommends for radish maggots a preparation made by adding 2 quarts of soft soap to 2 gallons of water, to which, when heated to the boiling point, 1 pint of crude carbolic acid is turned in. For use, one part of this mixture is mixed with 50 of water and sprinkled directly upon the plants once a week from the time they appear above the ground.

Carbolized Plaster.—This is simply one pint of crude carbolic acid well mixed with 50 lbs. land plaster. It is said to be very efficient as a deterrent remedy for flea-beetles.

7. *Tobacco.*—This has been used for a long time for fumigating greenhouses; but from recent experiments it seems to be worthy of wider application. Prof. J. B. Smith found that a very useful decoction could be made by boiling down 1 pound of tobacco until 1 pint of liquid contained all that could be extracted from it. This was diluted with 1 gallon of water, and was very effective in killing plant-lice, flea-beetles and other insects.

Tobacco has also been used as a wash for freeing stock of vermin, and is very effective; but is inferior, for this purpose, to kerosene emulsion.

PART II.

INSECTS INJURIOUS TO GRAIN AND FORAGE CROPS.

1. The American Frit Fly. (*Oscinis variabilis*, Loew).—This is an insect which has only been recently noticed as a serious crop pest. Its life history has not yet been carefully worked out; but it seems to be very similar to those of the Hessian Fly and Wheat-stem Maggot. It is known that as a small yellowish-white maggot, $\frac{1}{12}$ inch in length, it attacks severely spring wheat and many grasses at the base of the stem, just beneath the surface of the ground, and also that it passes the winter in the same situation upon winter wheat and grasses, and may be found in the spring as a pale brown pupa $\frac{1}{12}$ inch in length, of the shape shown, greatly magnified, at Fig. 2.

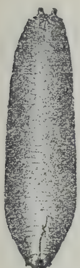

Fig. 2.

Remedies.—Until more is known definitely about the number of broods there are of this insect during the year, I would suggest the the following: (i) Late sowing of winter-wheat; (ii) Harrowing of stubble soon after the crop is carried, so as to start the volunteer crop quickly, this latter to be ploughed in early in September; (iii) The application of a special fertilizer as a top-dressing when winter wheat is known to be attacked. This will help the injured plants to overcome the injury.

2. Clover-seed Midge (*Cecidomyia leguminicola*, Lintner).—The heavy loss from this insect in the clover-seed districts has awakened farmers to the necessity of practising the simple remedy advised by entomologists. This consists of feeding off or cutting clover before the end of June when the larva of the first brood matures and leaves the clover head to enter the ground and complete its changes. The perfect insects, forming the second brood, emerge from the ground just as the second crop of clover is coming into flower, and the females lay their eggs amongst the forming blossoms. From these eggs hatch minute, pink, legless maggots, which penetrate the pod and destroy the seed. About the time the seed is ripe they leave the clover and enter the ground, to pass the winter and emerge again the next spring just at the time the clover comes into flower.

3. Hessian Fly (*Cecidomyia destructor*, Say).—Two or three small whitish maggots embedded in the crown of winter wheat, or, in summer, just above the first or second joint (Fig 3). When full grown these maggots harden and turn brown, when they resemble small flax seeds. These change to small smoky-winged gnats, which appear in spring and autumn. The vast losses due to this insect are too well known to farmers, and even then there is no doubt that only a small proportion of the damage is recognised as caused by it.

Fig. 3.

Remedies.—(i.) Delay sowing winter wheat until after the third week in September, so that it does not come up until after the last brood of the Hessian Fly has disappeared; (ii.) Burn all rubbish from the threshing machine: in this way many of the flax seeds or pupæ will be destroyed as well as many weed seeds; (iii.) Harrow the stubble directly the crop is carried, so as to start a volunteer crop for the flies to lay their eggs upon—this latter to be ploughed in early in September; (iv.) Apply special fertilizers in spring to help a weak or injured crop to overcome the injury.

4. The Pea Weevil (*Bruchus pisi*, L.)—A small, brownish-grey, very active beetle, $\frac{1}{5}$ inch long, with two conspicuous black spots on the end of the body, which emerges from seed pease in autumn or in spring, leaving a small round hole. The egg is laid on the young pod and the grub eats its way into the pea, where it passes all its stages, emerging the same autumn or the following spring.

Fig. 4.

Remedies.—(i). Clean seed. Of great importance is sowing uninfested seed. When weevily pease are sown as seed the beetles emerge soon afterwards, and remain about the fields feeding on the plants until the young pods are formed. It is sometimes alleged that weevily pease are almost as good for seed as sound grain, and that the insect will not thrive in the colder parts of Canada. The use of weevily pease as seed is a great mistake, the germ of a very large proportion being, as a rule, destroyed, and those which do germinate producing weak plants. Although I have found that extreme cold (below 15° below zero, Fah.) certainly killed the weevils in two samples of pease, it would be a most unjustifiable

experiment to introduce infested seed into a district, trusting to the climate to destroy the weevils. In addition to this, the crop grown the first year from the infested seed would certainly be much injured.

(ii.) Bisulphide of Carbon.—When seed is known to be infested there are several ways of destroying the contained insects. The remedy most widely used by seedsmen, who have all the conveniences, is to place the seed to be treated in some close vessel and subject it to the vapour of bisulphide of carbon. This chemical vaporises when exposed to the air, and the vapour is so much heavier than air that it will run down through the mass of any seed upon the top of which it has been placed, and will destroy all contained insects. The quantity required is small, $\frac{1}{4}$ lb. being enough to disinfect 3 cwt. of pease. The method of using it is to place the grain in a perfectly tight bin or barrel, and then pour some of the bisulphide into a shallow vessel, and place it on the top, put on the cover and keep it tightly closed for forty-eight hours. The bisulphide does not injure the seed in any way, but it must be used with care, on account of its extreme inflammability. The seed must be emptied out, out of doors, and no light must be brought near it or an explosion will occur.

(iii.) Warm Storage.—If seed pease are stored in a warm room, in bags of canvas or strong paper, during the winter the weevils will emerge and die before the seed is required for sowing.

(iv.) Holding over Seed.—Pease can be held over until the second year after harvesting without injury, and the defective seed can be sorted out before sowing.

(v.) Soaking.—If seed be found to contain weevils at the time of sowing, and it is inconvenient to hold it over, the weevils can be drowned by placing the seed in soak for twelve hours before sowing. It must, however, be sown or dried at once, when taken out of the water.

5. Wheat Midge, "Weevil" (*Diplosis tritici*, Kirby).—Several small reddish maggots, $\frac{1}{8}$ inch long, crowding around the grains of wheat in the ear and causing them to shrivel. Some of these, when full grown, fall to the ground and pass the winter beneath the surface. Others remain in the ears of wheat and are harvested with the grain.

Remedies.—(i.) Burn all rubbish and screenings from the threshing machine, particularly in localities where the midge is prevalent; (ii.) Deep ploughing as soon as the crop is carried.

6. Wheat-stem Maggot (*Meromyza Americana*, Fitch).—A glassy-green, slender maggot, $\frac{1}{4}$ inch long, which attacks the base of the top joint of barley and wheat, causing the ear to turn white before the rest of the crop is ripe, also occurring in the root-shoots of winter wheat and rye and many grasses, where it passes the winter, to emerge the following spring as an active, yellowish-green fly, $\frac{1}{5}$ inch long, with shining green eyes and three dark stripes down the back.

Remedies.—The same as recommended for No. 1, the American Frit-Fly.

INSECTS INJURIOUS TO FRUITS.

7. Apple Aphis (*Aphis mali*, Fabr).—During the winter small, shining black eggs may be found upon the twigs of apple trees. From these eggs, early in spring, emerge green plant-lice, which attack the leaves.

Remedy.—Spray the trees, just before the buds burst, with kerosene emulsion. (Remedy II.)

Apple Worm.—*See* Codling Moth.

8. Beautiful Wood Nymph (*Eudryas grata*, Fabr.).—On grape vines may be found, in the month of August, highly coloured caterpillars with the body blue, ringed with orange bands and fine black lines, head orange and the whole body dotted with black tubercles. Fig. 6. These drop to the ground when full grown and turn to rough brown pupæ beneath rubbish or near the surface of the ground. In the following spring the beautiful moth shown at Fig. 5 appears. The upper wings are creamy-white and seal-brown; the under wings, deep yellow, bordered with deep brown.

Fig. 5.

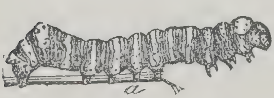

Fig. 6.

Remedy.—Hand-picking is usually practicable. Where very numerous, spraying with white hellebore or Paris green may be used. (Remedies I and III.)

Borers (Apple)—*See* Nos. 12 and 25.

9. Canker-Worms (*Anisopteryx vernata*, Peck, and *A. pometaria*, Harris).—There are two kinds of caterpillars which attack apple trees, and which are known as Canker-worms. Of one, the Spring Canker-worm, the wingless female moths appear chiefly in the spring and lay oval pearly-white eggs in irregular masses beneath flakes of bark, etc. Of the other, the Autumn Canker-worm, most of the moths appear late in the season and lay eggs which are flattened at the top (Fig. 7, *a, b, e,*) and laid regularly in clusters of about 100 or more on the outside of the bark. When full-grown the caterpillars of both are much alike, and are brownish-looking larvæ, about an inch in length. At Fig. 7 is shown the caterpillar and eggs of the Autumn Canker-worm. The females of both kinds are spider-like, wingless creatures; but the males are delicate moths, with gauzy gray wings.

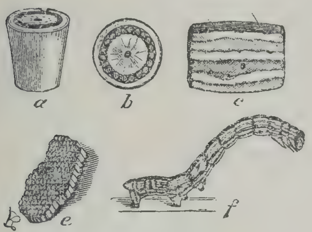

Fig. 7.

Remedy.—There are several mechanical contrivances for keeping the females from ascending the trees to lay their eggs; but none of these can compare for efficacy with spraying the trees in the spring time with Paris green, 1 pound to 200 gallons of water. If this be done immediately after the flowers have fallen both the Canker-worm and other leaf-eating insects, as well as the Codling Moth, will be killed at the same time.

Cherry Slug.—*See* Pear-Tree Slug.

10. Codling Moth (*Carpocapsa pomonella*, L.)—This is the destructive Apple-worm so well known to all growers and consumers of apples all over the world. The best remedy is spraying the trees once, immediately after the blossoms fall, with Paris green, at the rate of 1 pound to 200 gallons of water.

Currant-Worm, Gooseberry-Worm. *See* Imported Currant Saw-Fly.

11. Fall Web-Worm (*Hyphantria cunea*, Drury).—The unsightly webs made by colonies of this insect at the tops of branches upon fruit and shade-trees in the autumn are well known to every one.

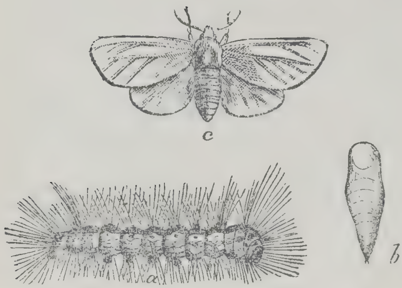

Fig. 8.

Remedies.—The eggs are laid by the female moth (Fig. 8), during June, and the webs are generally noticeable in July From the habit these caterpillars have of always remaining inside the web until a short time before they change to pupæ, an easy way of dealing with this pest is to cut off the web and destroy the contained caterpillars by crushing them under foot. If not attended to before they leave the web, of course, spraying the trees with Paris green will destroy this as well as all other leaf-eating insects.

12. Flat-headed Apple-tree Borer (*Chrysobothris femorata.* Fab.)—During June and July very active bronze beetles, about half an inch in length, and of the shape shown at Fig. 9, *d*, may be found laying eggs upon the trunks and large limbs of apple, mountain ash and other trees. These eggs soon hatch into the curious flat-headed or horse-shoe-nail shaped grubs shown at Fig. 9, *a*. These, after a time, eat into the trunk and bore broad and flat tunnels, which seriously injure the tree.

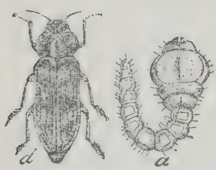

Fig. 9.

Remedy.—Undoubtedly the best remedy for this and all other borers which, as a rule, confine their depredations to a certain part of a tree, is of a preventive nature, and consists of applying an alkaline or poisonous wash to the trees just before the time the eggs are usually laid. For this purpose Remedy V or VI should be applied in the beginning and at the end of June.

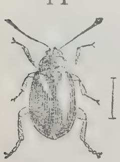
Fig. 10.

13. Grape-vine Flea-beetle (*Graptodera chalybea*, Illig).—At the time grape-vines are beginning to expand their buds a blue-black flea-beetle, $\frac{1}{4}$ inch long, is sometimes very abundant and injurious from destroying the buds and undeveloped flower-bunches.

Remedies.—Spraying the vines with Paris green, ¼ lb. to 50 gallons of water, at the time the beetles appear, and clean culture in the autumn, by which all leaves and rubbish are destroyed, amongst which the mature beetles would pass the winter, are the best remedies.

14. Grape-vine Leaf-hopper (*Erythroneura vitis*, Harris).—This insect, shown much enlarged in Fig. 11, and generally known by the misleading name of "Thrip," is one of the worst enemies of the grape and ornamental Virginian creeper. Like the last-mentioned insect, it passes the winter in the perfect form beneath rubbish and clods of earth. Clean culture is therefore beneficial. When the insect is abundant its presence is indicated by the white and blotched appearance of the leaves. The most successful treatment is to syringe the vines, as soon as the leaf-hoppers are observed, with kerosene emulsion. (Remedy II.)

Fig. 11.

15. Imported Currant-borer (*Ægeria tipuliformis*, L).—Early in June a beautiful little fly-like moth, with three bright yellow bands round the body (Fig. 12), may be seen darting about amongst currant bushes. This is one of the most troublesome enemies of the different kinds of currants. In my experience it has been far more injurious to black currants; but in some other parts of Canada it more generally affects the red and white varieties. The eggs are laid at a bud on the young wood, and the caterpillar when hatched eats its way into the cane and destroys the pith. It remains in the wood during the winter, and emerges the next June.

Fig. 12.

Remedy.—The only remedy is close pruning, and whenever a hollow cane is detected in pruning, the caterpillar must be hunted out and destroyed. Indications of the presence of the borer must also be looked for about the time the flowers are opening, when the leaves of infested shoots have a less healthy appearance.

16. Imported Currant Saw-fly (*Nematus ribesii*, Scop.)—Of all enemies to small fruits, there is not one perhaps which is more persistent than this insect. Soon after the leaves expand, early in May, the perfect insects, which are a little larger than a house-fly, may be seen flying about beneath gooseberry and currant bushes. The eggs

are laid in regular rows along the ribs beneath the lower leaves, and soon the well-known "Currant-worms" make their appearance.

Remedies.—There are at least two broods in the season. The caterpillars of the first of these appear in May, and *for this first brood only* a weak mixture of Paris green ($\frac{1}{4}$ oz. to a pailful of water is sufficient) may be sprayed on the bushes, or a dry mixture of 1 oz. of Paris green to 6 lbs. flour, well mixed together, may be dusted over the bushes after a shower, or when damp with dew. For the second brood of caterpillars, which appears just before the fruit ripens, Paris green must *on no account* be used, owing to its poisonous nature; but instead of it white hellebore, dusted on dry or in water, 1 oz. to a pailful of water.

17. Oyster-shell Bark-louse (*Mytilaspis pomorum*, Bouché).—Some might not at first recognise as insects the little roughnesses on the bark of apple trees shown in Fig. 13. Such however they are, and extremely injurious insects too. Their life history is peculiar. About the 1st June minute white mite-like insects, with six legs, emerge from beneath the scales on the bark and for two or three days run about seeking for a suitable place to attach themselves. They then pierce the young bark with their beaks and live on the sap of the tree. They never move from that place again. The waxy scale is gradually secreted, and by August the insect has transformed itself into a scale covering a cluster of eggs. These remain unchanged through the winter, and the young do not hatch again until the next June.

Fig. 13.

Remedies.—This insect, like many others, thrives most on unhealthy trees. When detected, therefore, measures should be adopted for inducing a vigorous growth, as well as for the removal of the scale insects. Spraying just before the buds open with kerosene emulsion (Remedy II) will destroy many of the scales—and again at the time the young lice are active, for at this time they are most susceptible to injury. Scrubbing the trunks and branches of young trees with alkaline washes (Remedy V and VI) during the winter or early in spring will also keep down the numbers of this pernicious insect.

18. Pear-tree Slug (*Selandria cerasi*, Peck).—In June and August slimy greenish-brown slug-like caterpillars, $\frac{1}{2}$ inch long,

occur on the leaves of pear and cherry trees, feeding on the upper surface.

Remedies.—The same as for No. 16.

19. Plum Curculio (*Conotrachelus nenuphar*, Herbst.)—There is perhaps no insect so well known by name as the Plum Curculio. The perfect insect (Fig. 14) belongs to the family known as snout-beetles, from the shape of the head, which is elongated into a beak. It is a small, rough, grayish beetle about $\frac{1}{5}$ inch long. The females lay their eggs in the young fruit of plums and cherries, frequently destroying the whole crop.

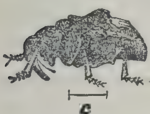

Fig. 15.

Remedies.—The beetles are sluggish in the early morning, and drop from the trees if a sudden jar be given to the trunk. For this purpose a metal spike is driven into the trunk, which is struck sharply with an iron hammer. This gives the sharp jar necessary to dislodge the beetles which fall on sheets or into receptacles placed beneath the trees. They are then collected and destroyed.

Of late years abundant evidence has proved the efficacy of spraying the trees, as soon as the fruit has formed, with Paris green, 1 lb. to 200 gallons of water, and ten days afterwards a second time with a weaker mixture, 1 lb. to 300 gallons. Should heavy rains occur immediately after these sprayings they must be repeated.

20. Raspberry Borer (*Oberea bimaculata*, Oliv).—Towards the end of June the tips of the young shoots of raspberries may frequently be seen to fade and droop. If these be examined there will be found, at the base of the faded portion, two rows of punctures half an inch apart, and between them a small hole leading into the heart of the cane, where one large yellow egg lies embedded. After a few days this egg hatches, and the young grub eats its way down the centre of the stem towards the root. It becomes full grown about August, when it is about $\frac{3}{4}$ inch long. The perfect insect (Fig. 15) emerges the next June as a narrow black beetle, with long feelers, and the thorax or middle portion of the body yellow, and bearing three black spots. It also attacks the blackberry.

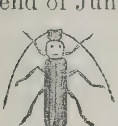
Fig. 15.

Remedy.—This is simple, but requires prompt action. The faded shoots are quite conspicuous, and when seen should at once be picked off. They separate from the cane with a light touch, and when removed the girdled portion should be examined, to see that the grub has not hatched and bored down into the stem.

21. Raspberry-cane Maggot (*Anthomyia?*).—There is another pest which affects the young wood of raspberries similarly; but does not produce the two rings of punctures. This is the maggot of a small black fly which lays a single egg in the axil of one of the upper leaves. The young maggot bores down the stem until full grown, and then changes to a brown puparium inside the stem.

Remedy.—After a time the young cane turns black at the tip and must be cut down as soon as seen. This is a more injurious pest than the last, where it occurs, because it burrows further down the stem before the indications of its presence are visible.

22. Raspberry Saw-fly (*Selandria rubi*, Harris).—About the time raspberries are in flower the leaves are noticed to be riddled with small holes. On examination this will be found to be the work of a green, bristly caterpillar (Fig 16). From the close resemblance in colour to the leaves on which they feed, these caterpillars are seldom recognized as the cause of the injury. They disappear from the canes before July, and form oval cocoons beneath the ground. From these the perfect insect, a small, dark four-winged fly, $\frac{1}{4}$ inch long, appears the next May.

Fig. 16.

Remedy.—Sprinkle the foliage as soon as the caterpillar's work is detected with white hellebore, 1 oz. in a pailful of water.

23. Raspberry Plume-moth (*Oxyptilus nigrociliatus*, Zeller).—In June another small caterpillar, somewhat like the last, but with finer bristles and of a paler green colour, may be found injuring the foliage in a very similar manner to the last. This, however, turns to a very beautiful little moth, bronze, dotted with silvery white (Fig. 17), which may be found flying about the canes in July.

Fig. 17.

Remedy.—The same as for No. 22.

24. Red-humped Caterpillar of the Apple (*Œdemasia concinna*, Sm. Ab.)—Late in summer large clusters of voracious waxy-looking, yellow, white and black caterpillars (Fig. 18), with their heads and a hump on the fourth ring of the body of a bright red, are sometimes found on young

Fig. 18.

apple trees, to which, unless they are removed, they are very destructive. Late in autumn they leave the trees and spin close but thin cocoons amongst fallen leaves. The caterpillars remain in these unchanged until the next spring, and the small brown moths emerge during June and July.

Remedy.—These caterpillars are nearly always found on young apple trees within reach from the ground. When this is the case the branch can be cut off and the caterpillars crushed under foot. When too high up for this a spraying with Paris green would dispose of them.

25. ROUND-HEADED APPLE TREE BORER (*Saperda candida*, Fab.)—This borer nearly always works near the base of the tree it infests. The grub is much thicker than that of the flat-headed borer, and takes three years, instead of one, to complete its changes. The beetle is pale-brown with two white stripes down the body. It is shaped somewhat like No. 15, but is stouter and about $\frac{3}{4}$ of an inch long

Remedies—During the first year the grub lives just beneath the bark in the sap wood, hollowing out a chamber about an inch or more in diameter. The bark becomes discoloured in a characteristic way which is soon recognised. It is also betrayed to the experienced eye by the castings which its pushes out of its burrows. By cutting through the bark the grub can be destroyed. If it has penetrated into the wood it can be killed with a piece of stout wire.

The best remedy, is undoubtedly, a regular treatment every June, with deterrent washes. *See* Remedies V and VI.

26. TENT CATERPILLARS (*Clisiocampa Americana*, Harris, and *C. disstria*, Hubn.)—The caterpillars, Fig. 20, which make the large, unsightly webs too often seen in the forks of branches of fruit and shade trees, hatch in May from rings of eggs which have been on the twigs of the trees all through the winter. They grow rapidly, and the perfect insect, an active brown moth, with two white bands across the wings, comes out in July. These insects are so well known that further description is unnecessary.

Fig. 19.

Remedies.—Where apple trees are sprayed for codling moth these caterpillars will also be destroyed. Hand-picking of the eggs in winter, and cutting off the webs when first formed in May, and when, owing to

the sparseness of the foliage, they are very conspicuous, are both practical remedies.

INSECTS INJURIOUS TO ROOTS AND VEGETABLES.

27. Cabbage Aphis (*Aphis brassicæ*, L.)—Grey plant-lice are frequently very troublesome during the summer on cabbages, and in August and September on smooth-leaved turnips.

Remedies.—(i.) In years of only moderate attack good results have been obtained by picking off the first clusters of plant-lice by hand and destroying them.

(ii.) The most satisfactory treatment, however, was upon a crop of heavily infested Swedish turnips with kerosene emulsion. This must be applied by means of a force-pump and spray nozzle, so set that the spray may be thrown up under the leaves where the plant-lice congregate.

(iii.) Prof. J. B. Smith recommends very highly whale-oil soap, 1 lb. to 8 gallons of water, for all plant-lice.

28. Cabbage Maggot (*Anthomyia brassicæ*, Bouché)—From one to many white maggots attacking the roots of young cabbages as soon as pricked out. These are produced from eggs laid by small gray flies, one-third smaller than house flies.

Remedies.—(i.) White hellebore, 2 oz. in a pailful of water, or (ii.) kerosene emulsion (Remedies II and III), syringed around the roots, and the earth kept well hoed up to the collar, have proved useful remedies; (iii.) Nitrate of soda, 1 tablespoonful around each plant, is highly recommended.

Cabbage-Worm.—*See* Imported Cabbage Butterfly.

Fig. 20.

29. Colorado Potato-beetle (*Doryphora 10-lineata*, Say).—In reply to frequent enquiries, I would state that for this insect no remedy can compare with Paris green, 1 lb. to 160 gallons of water (=1 oz. to 10 gallons). It is at once the cheapest and easiest applied remedy known.

30. Cucumber Flea-beetle (*Epitrix cucumeris*, Harris).—Very small black flea-beetles, with yellowish legs and feelers and covered with short, silky pubescence which eat a great many small holes in the leaves of cucumbers, potatoes, etc., etc.

Remedies.—These can be easily controlled by dusting Paris green and flour, 1 part to 50 of the diluent (Remedy I), over the plants when the dew is on them.

Fig. 21.

31. Cut-worms (*Noctuidæ*).—These troublesome pests, which are doubtless the cause of more loss to farmers in the spring months than any other insects, are the caterpillars of a number of different dull-coloured moths (Fig. 21), which fly at night. The worms one kind of which is shown at (Fig. 22) are smooth greasy-looking dark caterpillars, ranging from about ½ an inch to 2 inches in length at the time they injure crops. They feed at night and hide during the day time. The eggs of most species are laid in autumn, and the young caterpillars make about a quarter of their growth before winter sets in. They pass the winter in a torpid condition, and are ready in spring to attack the young crops as soon as they come up. The full growth of most species is completed by the first week in July, when the caterpillar forms a cell in the earth and changes to a chrysalis, from which the moth appears about a month later.

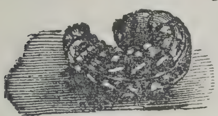

Fig. 22.

Remedies.—(i.) Clean Culture. As the young caterpillars of many species hatch in autumn, the removal of all vegetation from the ground as soon as possible in autumn deprives them of their food supply and also prevents the late-flying moths from laying their eggs in that locality. Fields or gardens which are allowed to become overgrown with weeds or other vegetation late in the autumn are almost sure to be troubled with cut-worms the next spring.

(ii.) Traps.—Large numbers may be destroyed by placing between the rows of an infested crop, or at short distances apart on infested land, bundles of any succulent weed or other vegetation which has been previously poisoned by dipping it, after tying in bundles, into a strong mixture of Paris green. The cut-worms eat the poisoned plants and bury themselves and die. In hot, dry weather these bundles should be placed out after sun-down, and a shingle may be placed on each to keep it from fading.

(iii.) Banding and Wrapping. (*a.*) It will be found to well repay the trouble and expense to place a band of tin around each cabbage or other plant at the time of setting out. These may very easily be made by taking pieces of tin 6 inches long and 2½ wide and bending them around a spade or broom handle so as to form short tubes. In placing them around a plant the two ends can be sprung apart

to admit the plant, and then the tube should be pressed about half an inch into the ground. I have found this a useful means of disposing of empty tomato and other cans. To prepare these easily, they need only be thrown into a bonfire, when the tops and bottoms fall off and the sides become unsoldered. The central piece of tin can then be cut down the centre with a pair of shears, and forms two tubes.

(*b.*) Wrapping a piece of paper round the stems of plants when setting them out will also save a great many.

(*c.*) Hand-picking or digging out the cut-worm whenever a plant is seen to be cut off should, of course, always be practised.

Natural Enemies.—There are two enemies which deserve especial notice, and, from the good service they do, should be known by sight to every cultivator. They are the Fiery Ground-beetle or Cut-worm Lion (*Calosoma calidum*, Fab.) and the Black Ground Wasp (*Ammophila luctuosa*). Both of these are desperate enemies of cut-worms, the former feeding on them in all of its stages, the latter digging them out and storing its nest with them as food for its young grubs.

Fig. 23.

Fig. 24.

32. Imported Cabbage Butterfly (*Pieris rapæ*, L.).—The white butterflies which fly over cabbage beds during summer lay eggs on the leaves, from which are hatched the troublesome Cabbage-worms.

Remedies.—The best remedy for this insect is undoubtedly insect powder diluted with four times its weight of common flour, as directed under Remedy IV.

Fig. 25.

33. ONION MAGGOT (*Phorbia ceparum*, Meigen.)—Equalling in destructiveness and more difficult to deal with than the Cabbage and Radish Maggots, is the Onion Maggot (Fig. 26.)

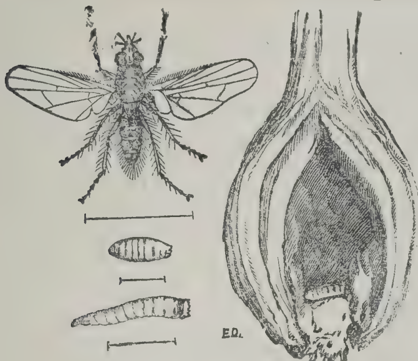
Fig. 26.

Remedies.–Rich, well-worked soil and early planting are advised.

(i). Kerosene emulsion watered along the rows when the onions are found to be infested has proved successful.

(ii). A sprinkling of gas-lime, sown broadcast over the beds every two weeks, was also found to protect the crops considerably, and was thought to act as a good fertilizer.

Suggestion.—I would suggest the use of Nitrate of Soda, at the rate of 200 lbs. to the acre; this is a valuable fertilizer, and has been found of marked use in checking the ravages of the Cabbage Maggot.

34. RADISH MAGGOT (*Anthomyia radicum*, Bouché).—The most serious pest of radishes is the root maggot. This is the larval form of a small fly closely resembling the fly of the Onion maggot (Fig. 26).

Remedies.—Early sowing and the use of new ground are recommended, but are by no means sure remedies. I have obtained the best results from using Prof. A. J. Cook's carbolic wash, Remedy IV. The use of salt and gas lime are also beneficial, but are not infallible remedies.

35. SQUASH BUG (*Anasa tristis*, De Geer).—Numbers of large, ill-smelling, dark-brown bugs, paler beneath, $\frac{3}{5}$ inch long, clustering round squash vines about the end of June and sucking the tops. The eggs are laid on the leaves, and the young are soon found with the full grown bugs.

Fig. 27.

Remedies.—Constant hand-picking, from the vines when they first appear, and by placing shingles close to the hills beneath which the bugs hide during the day time, are generally effective. Coal oil and plaster scattered amongst the vines will drive away many.

36. STRIPED CUCUMBER BEETLE (*Diabrotica vittata*, Fab.)—As soon as squash, cucumber or melon plants appear above the ground they are attacked by small, yellow-striped beetles, which if not noticed will soon destroy the plants.

Remedies.—Sifting dry ashes and Paris green (1 to 50) over the vines is the best application to protect the vines. Ashes alone are also useful. A remedy much adopted in the United States is described by Dr. C. M. Weed in a Bulletin of the Ohio Agricultural Exper't. Station for September, 1889, and consists of covering the vines with a piece of gauze or cheesecloth, supported by two or three sticks stuck into the ground, and with the edges held down by a handful of earth on each side.

37. TURNIP FLEA-BEETLE (*Phyllotreta vittata*, Fab.).—There is, perhaps, no insect better known or more execrated by farmers than "the fly" or flea-beetle of the turnip (Fig. 28). The perfect beetles, black, with white marks on the wings, pass the winter beneath rubbish or clods of earth, and appear on various plants of the cress family early in spring. As soon as the young turnips appear they attack the seed leaves, and very frequently destroy the whole crop. The grub state is passed under ground on the roots of plants of the cress family.

Fig. 28.

At Fig. 28. The perfect beetle and the grub are shown much enlarged.

Remedies.—I have found the most successful treatment of this insect to be the sowing of perfectly dry land plaster or ashes, with 50 parts of which 1 part of Paris green had been mixed (Remedy I). Other experimenters speak highly of a decoction of waste factory tobacco, 1 lb. in 2 or 3 gallons of water. This latter remedy is useful upon Garden Cress, where Paris green cannot be used. See also remedy for No. 36.

TO CORRESPONDENTS.

All enquiries about insects will be gladly replied to. They should always, when possible, be accompanied by specimens, which may be packed in any small tin or wooden box; when alive, place with them some of the foodplant. The box should be as tight as possible, and no air-holes are necessary. When the specimens are dead they should be rolled in paper or cotton. Specimens should never be sent unprotected in a letter or they are almost certain to be crushed beyond recognition. When writing for information as full particulars as possible should be given of the crop injured, and the part attacked, how long it has been noticed and the amount of damage done. Packages should be marked with the name and address of the sender, and should be directed to

THE ENTOMOLOGIST,
CENTRAL EXPERIMENTAL FARM,
OTTAWA, ONT.

N.B.—No postage is necessary on either letters or packages when addressed as above.

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CENTRAL EXPERIMENTAL FARM.

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DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - CANADA.

—:o:—

BULLETIN No 12.

—:o:—

PART I.—Indian Corn or Maize as a Fodder Plant.

PART II.—Report on the Chemical Composition of certain varieties of Indian Corn.

—:o:—

JUNE, 1891.

To the Honourable,

The Minister of Agriculture.

SIR,—I beg to submit for your approval the twelfth Bulletin from the Central Experimental Farm, relating to a crop of very great and growing importance to this country, namely, that of Indian Corn or Maize. The use of this plant for fodder, either dried or made into ensilage, is having the effect of materially lessening the cost of feeding stock through the winter, and from experience already gained it promises to be a most useful factor in stimulating winter dairying. The first part, which has been prepared by myself, treats of the methods of cultivation, the growth and productiveness of the many varieties which have been tested at the Experimental Farm during the past two years, and the cost of preparing ensilage. The second part, prepared under my direction by Mr. Frank T. Shutt, Chemist of the Dominion Experimental Farms, relates to the chemical composition of corn at different stages of its growth, a work which has been undertaken mainly for the purpose of showing at what period this crop can be most profitably cut. Analyses are also given of the ensilage prepared at the Farm.

I have the honour to be,

Your obedient servant,

WM. SAUNDERS,

Director Experimental Farms.

Ottawa, 16th June, 1891.

CENTRAL EXPERIMENTAL FARM.

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DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - CANADA.

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PART I.

INDIAN CORN OR MAIZE AS A FODDER PLANT.

BY WM. SAUNDERS, F.R.S.C., F.L.S., F.C.S.,
Director Dominion Experimental Farms.

There are few subjects more important at the present time to the farmers of Canada than that of the economical winter feeding of stock. The man who carries on mixed farming is, as a rule, the successful farmer. To depend for returns on the sale of cereals alone, or the disposal of hay grown on the farm is a wasteful course, which, however rich the soil may be, will sooner or later reduce it to such a condition of exhaustion as to make cropping unprofitable. But when the growing of grain and hay is associated with the raising of stock and pasturing, and where a large proportion of what is grown on the land is fed to cattle on the farm, the manurial constituents obtained will, if well cared for and returned to the soil, materially aid in maintaining its fertility for a very long period. Farmers do not always realize that with every load of grain they sell they dispose of a part of the valuable constituents of their land in the important ingredients which this grain has taken from the soil and stored in its substance, and this process of drawing continually on the fertility of the land without making adequate returns is just as certain to result in impoverishment as would frequent drafts without deposits on a limited balance in a bank.

With the immense plains in the North-West to compete with, where the soil is extremely rich and capable of producing grain in abundance and of high quality for many years without the use of fertilizers, it is unlikely that farmers in the eastern Provinces can continue to grow wheat as a staple crop with profit, hence more attention will no doubt be given by them in future to stock-raising and to dairying. Already the annual exports of Canadian cheese amount to over 88 million pounds, and the business has by no means reached its limit, and with similar effort and skill brought to bear on the production of butter, a large and profitable trade could soon be built up in that commodity. During the summer season the pasture lands of most eastern farms usually furnish rich and luxuriant herbage; the great desideratum is cheap and nutritious food for the long winter months when cattle have to be housed, food so stored as to be convenient, and handled with little expense.

In the North-West also Canadian farmers are learning that it is unwise to trust entirely to grain growing, and in Manitoba and the Territories mixed farming is becoming more general. There has been a prodigious increase in the number of cattle in that country within the past five years, and dairying enterprise is beginning to be developed. As long as the number of cattle there was small, and but a limited proportion of the land taken up, the western plains afforded unlimited pasturage for stock, and the lower lands furnished an abundance of hay for winter use, which could be had almost for the cutting. Now the conditions are changing. The land is being rapidly settled and the nearer unoccupied hay lands are no longer sufficient to provide winter sustenance for the increasing herds, and the farmer has either to drive his cattle a long distance from home and put them into rude winter quarters near his hay supply or to draw his hay, in many instances, from 25 to 50 miles to feed his animals at home. With the steady influx of settlers, farmers there must soon face the problem of growing on their own land winter food for their stock.

TIME OF CUTTING, SELECTION OF VARIETIES, ETC.

Indian corn, where it can be successfully grown, produces probably a greater weight of crop per acre than any other fodder plant. It is nutritious and a very large quantity can be grown at a small cost. In the growth of this plant stores of nutriment are gradually laid up in its stalks and leaves until it reaches that stage when the grain is formed, but still in a soft condition, when the

ears are said to be "glazed." Then the plant can be cut and stored at greatest profit to the grower. If cut before this it is soft and watery and deficient in nutritive matter, and if the cutting is delayed much later, portions of the stalks and leaves become impoverished and woody, from the transfer to the growing grain of a part of the nutriment they contain. Hence, whether corn is to be cured and fed dry, or made into ensilage it should be cut when the ears have reached the "glazed" condition. Some of the larger sorts of fodder corn which produce very heavy crops are late in ripening, and in those locations where the growing season is short they do not reach their best condition before frost comes, there, earlier ripening varieties are to be preferred. These earlier sorts usually produce less weight of fodder than the later ones, but it is better for the farmer in such localities to grow a somewhat lighter crop of nutritious food than a larger weight of a more watery character. Experience has shown that fodder corn, especially when made into ensilage, and associated with a little bran or some provender made by grinding the coarser grains, supplies a cheap ration on which cattle may be fed during the winter with good results either for dairy purposes or for beef. In No. 4 Dairy Bulletin, prepared by James W. Robertson, Dairy Commissioner for the Dominion, much useful information has been given on the growing of corn, the construction of the silo and the preparation of ensilage. This subject being so important to farmers in all parts of Canada, experiments have been carried on at the Central Farm at Ottawa during the past two years with a large number of varieties of corn for the purpose of ascertaining their relative earliness and yield. Tests have also been made during the past year at each of the branch experimental farms with a similar object in view. In these experiments the different varieties have been grown side by side on nearly uniform soil. Those classed as dent or tooth corn have in most instances produced the greatest weight of fodder, but have been the latest to ripen. The flint and sweet varieties vary much in their time of ripening, also in the vigour of their growth and relative productiveness. The results obtained at the Central Farm will be given here. The experience gained at the branch farms has already been published in the Annual Report for 1890.

DIFFERENT CLASSES OF CORN.

Indian corn may be conveniently divided into four classes. 1st, the varieties of dent corn, which are readily distinguished from other

sorts by the tooth-like form of the kernels; 2nd, flint corn, in which the upper end of the kernel is rounded and smooth; 3rd, sweet corn, which may be known when ripe by the wrinkled surface of the grain; and 4th, pop corn, the ears of which are small, the kernels small, hard and closely set on the ears and more or less pointed in form.

ESTIMATES OF YIELD, CHARACTER OF SOIL.

All the varieties enumerated in the following lists were sown in rows 3 feet wide with the kernels from 3 to 6 inches apart in the rows, and the calculations of the weight per acre are based in most instances on the yield of two rows of 100 feet each. Estimates based on the yield of small plots usually give larger results than can be obtained where the varieties are grown by the acre. They are, however, sufficiently accurate for the purpose of comparing the relative yield of different sorts. Much also depends on the condition of the land as to fertility. The experimental corn plots in 1889 were on a sandy loam, most of it rather light, which sown with roots in 1887 and received a coating of stable manure about 20 tons to the acre in the spring of 1888. This was followed by a crop of spring wheat. The land was ploughed in the fall and harrowed in the spring of 1889, first with a disc harrow and after that with the common iron harrow, and a dressing of about 200 lbs. per acre of a special corn fertilizer was used on the rows immediately after planting.

The land chosen for the corn plots in 1890 was a light sandy loam which was in pasture for several years before the farm was purchased. It was ploughed in the fall of 1887, a crop of oats was grown on it in 1888, a second crop of oats in 1889, and corn plots in 1890. This land has had no manure whatever nor any other fertilizer applied to it for many years, how many I am not able to say. The poverty of this soil, as compared with that selected for the corn plots last year, and the fact that no fertilizers were applied will probably account for the larger yield obtained in most instances in 1889. This poor piece of unmanured land was selected for the purpose of showing what crops of corn could be raised in the Ottawa district under unfavourable conditions, and at the same time gaining information as to the growth and yield of the different varieties under such circumstances.

VARIETIES OF DENT OR TOOTH CORN.

Name of Variety.	Year when tested	Date of Planting.	When Up.	When Tasselled.	When Cut.	Height.	Leafiness.	Condition of Ears.	Yield per Acre. Tons.	Lbs.
Adams' Early	1889	May 21	June 4	Aug. 24	Sept. 7	7 to 8 ft.	Very leafy	Well filled	26	140
do	1890	do 22	do 1	do 6	do 9	6 to 7 ft.	Fairly leafy	Well filled	19	78
Brazilian Flour	1889	do 21	do 4	....	do 7	8 ft.	Very leafy	No ears formed	39	1200
Blunt's Prolific	1889	do 21	dô 4	....	do 7	8 to 9 ft.	Very leafy to tip	Just forming	30	1380
do	1890	do 22	do 2	Aug. 24	do 9	8 to 10 ft.	Very leafy	Scarcely formed	25	747
Cranberry White Dent	1889	do 21	do 4	do 24	do 7	8 to 10 ft.	Fairly leafy	About half grown	23	530
Coen	1889	do 21	do 4	do 24	do 7	8 to 10 ft.	Very leafy	Just formed	25	490
Calico Dent	1889	do 21	do 4	do 24	do 7	7 to 8 ft.	Very leafy	About half grown	18	1620
Chester County Mammoth	1890	do 22	do 2	do 15	do 9	8 to 11 ft.	Very leafy	Soft and watery	26	925
Edmund's Premium Dent	1889	do 21	do 4	do 24	do 9	7 to 9 ft.	Fairly leafy	One-third grown	21	1890
Golden Dent	1889	do 21	do 3	do 24	do 7	9 to 11 ft.	Fairly leafy	Scarcely formed	32	680
do	1890	do 22	do 1	do 22	do 9	9 to 10½ ft.	Very leafy	Scarcely formed	26	1361
Golden Beauty	1889	do 21	do 3	do 24	do 7	9 to 10 ft.	Very leafy	About half grown	38	1880
do	1890	do 22	do 1	do 17	do 9	10 to 12 ft.	Fairly leafy	Scarcely formed	31	36
Giant Prolific Ensilage Sweet	1890	do 22	do 2	do 15	do 9	10 to 12 ft.	Fairly leafy	Early milk	21	1451
Hickory King	1889	do 21	do 4	do 24	do 7	8 to 9 ft.	Very leafy	Scarcely formed	24	180
do	1890	do 22	do 1	do 19	do 9	7 to 8 ft.	Very leafy	Early milk	24	859
Hybrid Fodder from P. C. Dempsey, Trenton, Ont.	1890	do 22	do 1	do 13	do 9	7 to 8½ ft.	Fairly leafy to tip	In early milk	23	1298
King of the Earlies	1889	do 21	do 3	do 24	do 7	8 to 9 ft.	Fairly leafy	Scarcely formed	23	200
Leaming Yellow	1889	do 21	do 4	do 24	do 7	8 to 9 ft.	Fairly leafy	One-fourth grown	29	80
do do	1890	do 22	do 1	do 14	do 9	7 to 10 ft.	Very leafy	Partly grown	26	235
Mastodon Field	1889	do 21	do 3	do 24	do 7	8 to 10 ft.	Very leafy	Scarcely formed	29	1730
Mammoth White Surprise	1890	do 22	do 2	do 26	do 9	8 to 10 ft.	Fairly leafy	Scarcely formed	19	1784
Mammoth Southern Sweet	1889	do 21	do 4	do 24	do 7	9 to 11 ft.	Very leafy	Half grown	28	1575
do do	1890	do 22	do 1	do 27	do 9	9 to 10 ft.	Fairly leafy	Half grown	27	87
Maryland White Ground Seed	1890	do 22	do 1	do 18	do 9	9 to 10 ft.	Fairly leafy	Scarcely in early milk	23	1117

VARIETIES OF DENT OR TOOTH CORN—*Continaed.*

Name of Variety.	Year when tested	Date of Planting.	When Up.	When Tasselled.	When Cut.	Height.	Leafiness.	Condition of Ears.	Yield per Acre. Tons.	Lbs.
Mammoth Dent	1890	May 22	June 2	Aug. 16	Sept. 9	10 to 11 ft.	Very leafy	Scarcely in early milk.	27	486
North Shore Yellow Dent	1889	do 21	do 4	do 24	do 7	7 to 9 ft.	Fairly leafy	Half grown	19	280
Old Cabin Home	1890	do 22	do 1	do 23	do 9	10 to 12 ft.	Fairly leafy	Scarcely formed	25	747
Parish White Dent	1889	do 21	do 3	do 24	do 7	8 to 10 ft.	Very leafy	Scarcely formed	27	120
Pride of the North	1889	do 21	do 4	do 24	do 7	7 to 8 ft.	Very leafy	One-third grown	21	240
Queen of the Prairie	1889	do 21	do 3	do 24	do 7	8 to 9 ft.	Fairly leafy	One-third grown	30	1030
do do	1890	do 22	do 1	do 5	do 9	8 to 10 ft.	Fairly leafy	Nearly in late milk	22	1919
Red Cob Ensilage	1889	do 21	do 4	do 24	do 7	8 to 9 ft.	Very leafy	Scarcely formed	26	1130
do do	1890	do 22	do 1	do 12	do 9	10 to 11 ft.	Fairly leafy	Scarcely formed	28	10
Southern Ensilage	1889	do 21	do 4	do 24	do 7	8 to 10 ft.	Very leafy	Just forming	24	180
Snowflake	1890	do 22	do 2	do 11	do 9	9 to 10 ft.	Fairly leafy	Early milk	22	1219
Wisconsin White Dent	1889	do 21	do 3	do 24	do 7	8 to 9 ft.	Fairly leafy	Early milk	27	120
Wisconsin Yellow Dent	1889	do 21	do 3	do 24	do 9	8 to 9 ft.	Fairly leafy	Just formed	21	1890
Woodward's Dent	1889	do 21	do 4	do 24	do 7	7 to 8 ft.	Fairly leafy	Just formed	17	1310
Virginia Horse Tooth	1889	do 21	do 3	do 24	do 7	9 to 11 ft.	Very leafy	Scarcely formed	36	930
do do	1890	do 22	do 1	do 26	do 9	9 to 12 ft.	Very leafy	Scarcely formed	31	653

VARIETIES OF FLINT CORN.

Name of Variety.	Year when tested	Date of Planting.	When Up.	When Tasselled.	When Cut.	Height.	Leafiness.	Condition of Ears.	Tons.	Lbs.
Angel of Midnight	1889	May 21	June 3	Aug. 24	Sept. 7	7 to 8 ft.	Quite leafy	Nearly in early milk	17	980
do do	1890	do 22	do 2	do 1	do 9	5 to 6 ft.	Fairly leafy	Nearly ripe	15	129
Adams' Extra Early	1889	do 21	do 3	do 20	do 7	4 ft.	Fairly leafy	Ripe	8	170
do do	1890	do 22	do 1	do 19	do 9	4 to 5 ft.	Fairly leafy	Ripe	13	1660
Canada Yellow	1890	do 22	do 1	July 31	do 9	5 to 6 ft.	Very leafy	Nearly ripe	18	9

Golden Dew Drop	1890	do 22	do 1	Aug. 1	do 9	6 to 7 ft.	Fairly leafy	Ripe	15	1726
King Phillip	1889	do 21	do 4	do 20	do 7	7 to 8 ft.	Fairly leafy	Nearly ripe	20	920
do	1890	do 22	do 1	do 10	do 9	6 to 7 ft.	Fairly leafy	Almost ripe	19	1675
Long White Flint	1889	do 21	do 3	do 24	do 7	8 to 10 ft.	Very leafy	Scarcely formed	30	720
do do	1890	do 22	do 1	do 13	do 9	6 to 7 ft.	Very leafy	In early milk	22	286
Longfellow	1889	do 21	do 4	do 18	do 7	6 to 7 ft.	Fairly leafy	Nearly ripe	25	1150
do	1890	do 22	do 1	do 2	do 9	5 to 6½ ft.	Very leafy	Late milk	18	1425
Long Yellow Flint	1889	do 21	do 4	do 20	do 7	7 to 8 ft.	Very leafy	Ab't two-thirds ripe	20	1910
do do	1890	do 22	do 1	do 4	do 9	8 to 10 ft.	Fairly leafy	Late milk	26	1433
Large White Flint	1890	do 22	do 1	do 3	do 9	7 to 8 ft.	Fairly leafy	Early milk	24	1077
Landreth's Early Summer Yellow Flint	1890	do 22	do 2	do 1	do 9	6 to 7½ ft.	Fairly leafy	Nearly ripe	19	1966
Mitchell's Extra Early Flint	1890	do 22	do 2	July 20	do 9	5 to 6½ ft.	Fairly leafy	Ripe	12	1083
Pearce's Prolific	1890	do 22	do 2	July 29	do 9	7 to 8 ft.	Fairly leafy	Nearly ripe	23	1843
Self Husking	1889	do 21	do 3	Aug. 15	do 7	6 to 7 ft.	Fairly leafy	Ripe	13	400
do do	1890	do 23	do 3	July 30	do 9	6 to 7½ ft.	Fairly leafy	Ripe	17	339
Smut-Nose Flint	1889	do 21	do 4	Aug. 18	do 7	6 to 7 ft.	Fairly leafy	Nearly ripe	15	1350
Thoroughbred White Flint	1889	do 21	do 4	do 14	do 7	8 to 9 ft.	Very leafy to the top	Late milk	40	380
do do	1890	do 22	do 1	do 12	do 9	8 to 10 ft.	Very leafy	Early milk	25	1255
Yellow Dutton	1890	do 22	do 1	do 13	do 9	8 to 9 ft.	Very leafy	Early milk	25	239

VARIETIES OF SWEET CORN.

Amber Cream	1889	May 21	June 4	Aug. 25	Sept. 7	6 to 7 ft.	Fairly leafy	Two-thirds ripe	19	1930
do do	1890	do 22	do 2	do 6	do 9	5 to 6 ft.	Fairly leafy	Late milk	17	775
Asylum Sweet	1889	do 21	do 4	do 20	do 7	7 to 8 ft.	Fairly leafy	Late milk	25	160
do do	1890	do 22	do 1	do 6	do 9	7 to 8 ft.	Fairly leafy	Late milk	24	460
Burbank's Early	1889	do 21	do 4	do 14	do 7	4 to 5 ft.	Fairly leafy	Nearly ripe	15	690
Black Mexican	1889	do 21	do 4	do 14	do 7	6 to 6½ ft.	Fairly leafy	Two-thirds ripe	12	750
do do	1890	do 22	do 2	do 9	do 9	6½ to 7½ ft.	Fairly leafy	Late milk	18	1897
Ballard's Early	1890	do 22	do 1	July 26	do 9	5 to 6 ft.	Not very leafy	Almost ripe	13	1588
Crosby	1889	do 21	do 3	Aug. 10	do 7	6½ to 7 ft.	Fairly leafy	Ripe	27	780
do	1890	do 22	do 1	do 1	do 9	4½ to 5½ ft.	Very leafy	Nearly ripe	18	1062
Chicago Market	1889	do 21	do 4	do 10	do 7	5½ to 6 ft.	Very leafy	Three-fourths ripe	16	1530
do do	1890	do 23	do 3	July 28	do 9	5½ to 6½ ft.	Fairly leafy	Nearly ripe	12	974
Dolly Dutton	1890	do 22	do 2	do 26	do 9	5 to 6 ft.	Fairly leafy	Past late milk	14	1257

VARIETIES OF SWEET CORN—*Continued.*

Name of Variety.	Year when tested	Date of Planting.	When Up.	When Tasselled.	When Cut.	Height.	Leafiness.	Condition of Ears.	Yield per Acre. Tons.	Lbs.
Darling's Early..........	1890	May 23..	June 2..	Aug. 3..	Sept. 9..	6 to 7 ft.	Fairly leafy....	Past late milk......	18	626
Eight-rowed Sugar.........	1889	do 21 .	do 2..	do 14..	do 7..	7 to 8½ ft.	Very leafy......	Early milk.........	26	1905
do do	1890	do 22..	do 2..	do 7..	do 9..	7 to 8 ft.	Fairly leafy.....	One-third grown...	21	1890
Excelsior	1889	do 21..	do 4..	do 20..	do 7 .	6 to 7 ft.	Fairly leafy.. ..	Two-thirds ripe ..	13	1390
do	1890	do 22..	do 2..	do 2..	do 9..	6 to 7 ft.	Fairly leafy.....	Late milk.........	8	988
Egyptian Sugar	1889	do 21..	do 5..	do 20..	do 7..	6 to 7 ft.	Very leafy.....	One-third grown...	24	1830
do do	1890	do 22..	do 4 .	do 13..	do 9..	8 to 9 ft.	Very leafy.....	Early milk.... . ..	26	54
Early Golden Yellow Sugar.	1890	do 22..	do 4..	July 31..	do 9..	5 to 6½ ft.	Fairly leafy. ...	Late milk.......	16	524
Extra Early Cory.....	1889	do 21..	do 4..	Aug. 4..	do 7..	4 to 4½ ft.	Fairly leafy.....	Ripe.....	8	170
do do	1890	do 22..	do 1..	July 17..	do 9..	4 to 5 ft.	Fairly leafy.....	Ripe	13	664
Ford's Early	1889	do 21..	do 4 .	Aug. 14..	do 7..	6 to 6½ ft.	Fairly leafy.....	Ripe	15	360
Golden Coin.....	1890	do 23..	do 2..	do 21..	do 9..	7 to 9 ft.	Very leafy......	Early milk.........	21	362
Hickox	1889	do 21..	do 4..	do 18..	do 7..	6 to 7½ ft.	Very leafy.....	Two-thirds ripe....	19	610
do	1890	do 22..	do 1..	do 6..	do 9..	6 to 7 ft.	Very leafy......	Nearly ripe.......	20	38
Honey Sweet.......... ...	1890	do 23..	do 4..	do 6..	do 9..	6 to 7 ft.	Fairly leafy....	Late milk	17	1864
Livingston's Evergreen. ...	1889	do 21..	do 4..	do 14..	do 7..	6½ to 7½ ft.	Very leafy.. ..	Nearly ripe	18	630
Landreth Sugar......... .	1890	do 22..	do 3..	do 6..	do 9..	6 to 7 ft.	Fairly leafy. ..	Late milk....	16	379
Landreth's Early Market...	1890	do 22..	do 2..	July 31..	do 9 .	7 to 8 ft.	Very leafy......	Nearly ripe	22	1556
Minnesota................	1890	do 22..	do 3..	do 30..	do 9..	6 to 7 ft.	Fairly leafy.....	Past late milk.. ...	20	1599
Marblehead Early.........	1889	do 21..	do 3..	Aug. 4..	do 7..	5 to 6 ft.	Very leafy at bottom.......	Ripe	12	1080
do do	1890	do 22..	do 2..	July 20..	do 9..	5 to 6 ft.	Fairly leafy.....	Nearly ripe........	13	862
Moore's Early Concord.....	1889	do 21..	do 4..	Aug. 10..	do 7..	7 ft.	Very leafy......	Two-thirds ripe ...	20	590
do do	1890	do 22..	do 2..	do 3..	do 9..	5 to 6 ft.	Fairly leafy.. ..	Late milk.........	16	1967
Mammoth Sugar......	1889	do 21..	do 4..	do 20..	do 7..	7 to 8½ ft.	Fairly leafy.....	Just formed	29	80
Mammoth Early........ ...	1890	do 22..	do 3..	do 16..	do 9..	7 to 9 ft.	Fairly leafy. ...	Early milk... . .	19	586
Mammoth Late	1890	do 22..	do 2..	do 14..	do 9..	7 to 9 ft.	Fairly leafy.....	Early milk...	22	1266
Narragansett Early	1889	do 21..	do 4..	do 4..	do 7..	6 to 7 ft.	Fairly leafy.....	Two-thirds grown..	16	670
do do	1890	do 22..	do 1..	July 25..	do 9..	5 to 6 ft.	Fairly leafy. ...	Past late milk......	15	972

Ne Plus Ultra...........	1889	do 21..	do 4..	Aug. 14..	do 7..	7 to 8 ft.	Fairly leafy...	Late milk.......	21	1230
do do	1890	do 22..	do 2..	do 8..	do 9..	6 to 7 ft.	Not very leafy...	Early milk........	13	1987
Northern Pedigree Sweet...	1889	do 21..	June 4..	do 14..	do 7..	4 ft.	Fairly leafy.....	Nearly ripe........	6	870
Old Colony	1889	do 21..	do 4..	do 20..	do 7..	7 to 9 ft.	Fairly leafy.....	Three-fourths ripe..	22	550
do	1890	do 23..	do 3..	do 8..	do 9..	7 ft.	Very leafy...	Late milk........	14	1584
Potter's Excelsior..........	1889	do 21..	do 3..	do 20..	do 7..	6 to 8 ft.	Fairly leafy.....	Almost ripe........	20	1910
do do	1890	do 22..	do 2..	do 6..	do 9..	6 to 7 ft.	Fairly leafy....	Past late milk...	20	438
Pee and Kay.	1889	do 21..	do 3..	do 14.	do 7..	5 to 6 ft.	Very leafy. ...	Ripe.	20	920
do	1890	do 22..	do 1..	July 31..	do 9..	5 to 6 ft.	Fairly leafy.....	Nearly ripe......	18	989
Perry's Hybrid Early	1889	do 21..	do 4.	do 4..	do 7..	5½ to 6½ ft.	Fairly leafy.....	Nearly ripe......	18	1290
do do	1890	do 22..	do 1..	July 25..	do 9..	4 to 5 ft.	Very leafy......	Nearly ripe......	14	59
Stowell's Evergreen........	1889	do 21..	do 3..	Aug. 20..	do 7..	5½ to 7 ft.	Very leafy ...	Half ripe.........	19	1270
do do	1890	do 22..	do 2..	do 10..	do 9.	5 to 6½ ft.	Very leafy.....	Late milk..........	18	481
Shaker's Early.............	1889	do 21..	do 4..	do 4..	do 7..	5 to 6 ft.	Fairly leafy.....	Nearly ripe......	20	590
Sweet Fodder..............	1890	do 22..	do 2..	do 8..	do 9..	6 to 7½ ft.	Very leafy......	Early milk... ...	19	1058
Stabler's Second Early.....	1890	do 22..	do 2..	do 8..	do 9..	6 to 8 ft.	Fairly leafy.....	Early milk.	21	579
Triumph Sugar	1889	do 21..	do 3..	do 14..	do 7..	6 to 8 ft.	Very leafy below	Late milk..........	24	30
do do	1890	do 22..	do 2..	do 6.	do 9..	5 to 6½ ft.	Fairly leafy. ...	Late milk.........	18	481
Tuscarora........	1890	do 23..	do 3..	do 5..	do 9..	7 to 9 ft.	Very leafy......	Early milk.	23	827
Talbot's First and Best.....	1890	do 22..	do 1..	July 19..	do 9..	3 to 4 ft.	Fairly leafy....	Ripe	10	1380

POP CORN.

Pop Corn from P. C. Dempsey	1890	do 22..	do 2..	do 23..	do 9..	6 to 7 ft.	Fairly leafy	Ripe.....	15	637
Cinquantine....	1890	do 22..	do 1..	do 28..	do 9..	6 to 7 ft.	Very leafy.	Ripe.............	18	300

The Cinquantine is a Greek Corn, which has been placed in this group for the reason that it closely resembles the Pop Corn, though of larger size.

One of the incidental advantages of a corn crop is that when well cultivated it thoroughly cleans the land, no matter how weedy it may be, and hence is as useful in this respect as a summer fallow or a root crop.

MODES OF CULTIVATION.

While the usual method of growing corn for fodder is in rows, it may also be planted in hills 3 feet apart each way with almost equally good results as to the weight of yield, while the plants being thus more exposed to sunlight will produce ears more freely. Some varieties grow much stronger than others, are more leafy, and stool more, sending up several shoots from the base. The Thoroughbred White Flint is probably the best example of this class. An acre of this variety grown at the Central Experimental Farm in 1890, cut and weighed green gave a little over thirty tons. Twenty tons to the acre is a fairly good yield.

RELATIVE VALUE OF ENSILAGE AND HAY.

Opinions differ as to the relative value of ensilage and hay; some careful observers claim that two tons of well-prepared ensilage are equal to one ton of hay, while others hold that three tons are required to furnish the same quantity of nutriment. It is not easy to demonstrate accurately the relative value of the two, for the reason that the corn when converted into ensilage has undergone changes which make it more easily digested, and hence in feeding, the nutritious matter is more completely assimilated and is not subject to so much waste as when hay is fed.

METHODS OF PRESERVATION.

Corn may be cut green, stacked in the field until dry—when it loses about half its weight—and stored near the barn during winter and cut up as required, or it may be placed in a silo and converted into ensilage. The early forms of silos were constructed of stone or brick and partly below ground, but the more recent structures are of wood with air spaces between to keep out frost. They can be made most cheaply in a mow of the barn, but when it is not convenient to do this a silo may be built against the barn, on the outside of it. It may be built of 2x12 timber sheeted with rough inch lumber on either side, then covered with dressed lumber with the joints broken. Full particulars for the construction of such a building will be found in the bulletin already mentioned, No. 4, of the Dairy series.

COST OF PRODUCING ENSILAGE.

The following are the details of cost of growing two acres of corn, in 1890, and putting it in the silo at the Central Experimental Farm. One acre was Thoroughbred White Flint, which yielded 30 tons; the other was two-thirds Giant Prolific Ensilage, and one-third acre divided between Pearce's Prolific, Virginia Horse-tooth and Golden Dent, the yield from this acre being 22 tons, 1,151 lbs., or a total on the two acres of 52 tons, 1,151 lbs. It was sown May 24, and cut September 10. The land chosen for this crop was adjoining that which was selected for the experimental corn plots in 1890 and had been cropped and treated in the same manner. For particulars of this see page 6. The only fertilizer used was the mixture referred to below, which was sown broadcast.

		$ cts.
Ploughing in Fall of 1889, $2 per acre		4 00
Disk harrowing, once, in Spring, 1890		0 80
Harrowing with iron harrow		0 40
Cost of seed, one bushel		1 75
Team, sowing, 2½ hours at 30c		0 75
Four times cultivating, with one-horse cultivator, 2½ hours each time at 50c		2 00
One man hoeing 3 days: 1½ days June 19 and 20; 1½ days June 29 and 30		3 75
Sept. 10, 2 men cutting one day		2 50
Drawing corn by teams to silo, 27 hours at 30c. per hour		8 10
Men loading, cutting and tramping in silo, 7 or 8 in all, 108 hours at 12½c		13 50
Two-thirds cost of Special Fertilizer—		
100 lbs. Sulphate Ammonia	$4 60	
400 lbs. Capleton Superphosphate at $16 per ton (Mixed and spread first.)	3 20	
400 lbs. unleached wood ashes. Applied separately afterwards	1 20	
	9 00	6 00
Use of engine and cutter, 1¼ days at $5		6 25
Foreman's wages, supervising work, say		7 50
Rent of land, say		8 00
		65 30

This is equal to about $1.25 per ton. Two-thirds only of the cost of the special fertilizer is charged to this crop, as it is believed that future crops would be benefitted to the extent of the other third; if the whole be charged this would add nearly six cents per ton to the

cost of production. Supposing a silo with a capacity for 100 tons to cost $100, twelve cents per ton might be added to cover interest and depreciation for this item. The waste on 100 tons at the Central Experimental Farm was 2,528 lbs., which would further add about three cents per ton, making the total cost $1.40 per ton, or including the full price of the fertilizers, $1.46. No other food so nutritious for the winter feeding of stock can be produced so cheaply as this. The silo, which is divided into two compartments of 16 x 18 feet and high enough to allow of its being filled to a depth of about 18 feet, each thus capable of holding about 100 tons, was filled from the 10th to the 20th of September.

The corn was cut in lengths of one-half to three-quarters of an inch and well trodden down, especially around the margins, and when filled the surface of one compartment was covered with about a foot of cut straw and not weighted, the other had no straw but was covered with boards and weighted with stones. When opened on the 1st of December the former was found in good condition, with but a small proportion of the top spoiled, the latter was blackened and partly decayed for from 4 to 6 inches in depth. In 1889 both divisions were covered with about a foot of cut straw and one only weighted with boards and stones, and in that instance there was less waste on the side weighted. Both years the ensilage came out in good condition, was sweet and malty in odour with a very slight acidity, and kept well throughout the winter. That put up in September, 1889, retained its good qualities to the time the last of it was used in July, 1890; that cured last season, is almost, if not quite as good now as when it was opened in December.

CORN SOWN AT DIFFERENT DISTANCES.

Tests were also made with several varieties of corn sown two kernels to the foot, four to the foot and twelve to the foot, also in rows 4 feet apart, 3½ feet, 3 feet, 2½ feet, 2 feet, and 14 inches, these latter with kernels all from 3 to 6 inches apart. Other plots were sown broadcast at the rate of three bushels per acre. In the following table the results of these several operations are given. The corn was sown on the 23rd of May, came up on the 2nd and 3rd of June, tasselled from the 15th to the 25th of August, and was cut on the 12th and 13th of September.

EXPERIMENTS WITH CORN PLANTED AT DIFFERENT DISTANCES.

Name of Variety.	Distance Apart.	Yield per Acre. Tons.	Lbs.
Golden Beauty	2 kernels to the foot	26	362
do	4 do do	24	642
do	12 do do	24	1186
Giant Prolific Ensilage	2 do do	19	1204
do do	4 do do	20	1200
do do	12 do do	20	1654
Red Cob Ensilage	2 do do	26	216
do	4 do do	26	1451
do	12 do do	28	83
Thoroughbred White Flint	2 do do	29	1259
do do	4 do do	24	912
do do	12 do do	27	813
Edmunds' Premium Dent	3 do do	26	1460
do do	12 do do	30	700
Leaming Yellow Dent	3 do do	27	780
do do	12 do do	25	1480
Excelsior Sweet	3 do do	15	1020
do	12 do do	21	1560
Giant Prolific Ensilage	In rows 4 feet apart	18	821
do do	do 3½ do	21	1279
do do	do 2½ do	18	24
do do	do 2 do	17	531
do do	do 14 inches apart	14	245
do do	Sown broadcast	19	1520
Thoroughbred White Flint	In rows 4 feet apart	19	890
do do	do 3½ do	24	9
do do	do 2½ do	22	1193
do do	do 2 do	17	303
do do	do 14 inches apart	19	1446
do do	Sown broadcast	19	926

From the results given it would appear that the Thoroughbred White Flint, Long White Flint, Long Yellow Flint, Yellow Dutton, Large White Flint, Pearce's Prolific, and Longfellow are the most productive of the Flint varieties, ranging in yield in the order named, and all of them excepting the Long White Flint attained a sufficient degree of maturity to make excellent ensilage.

Among the different sorts of Dent corn, none of which, however, mature as well as the Flint varieties, the following have been found to yield the greatest weight of crop: Virginia Horse-tooth, Golden Beauty, Golden Dent, Blunt's Prolific, Mammoth Southern Sweet, and Red Cob Ensilage.

Many sorts of sweet corn have given a large yield, the most prolific being Mammoth Sugar, Crosby, Eight-rowed Sugar, Egyptian Sugar, and Asylum Sweet. The earliest ripening among these is the Crosby.

PART 2.

REPORT

ON THE

Chemical Composition of certain varieties of Indian Corn.

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OBJECTS OF THE INVESTIGATION.

The following work was undertaken with two principal objects in view. First, to ascertain the relative values of certain varieties of Indian corn for fodder purposes; and, secondly, to arrive at a knowledge as to the best time for cutting, whether for the silo or for preservation in the dry condition. Incidentally, however, other points regarding the growth of the corn plant have received elucidation, and the information thus gained will, it is hoped, prove of service to the corn grower.

VARIETIES ANALYSED.

The varieties of corn experimented with are as follows: Queen of the Prairie, Angel of Midnight, Virginia Horsetooth, Golden Beauty, Early Adams, Long White Flint and Mammoth Southern. They were all cultivated in the same manner, viz., in rows 3 feet apart, and the soil was fairly uniform throughout. The samples taken for analysis were from the crop of 1889, and were cut at two stages of their growth, the first on the 26th August, and the second on the 19th September. In each case the sample consisted of not less than six average stalks, cut close to the ground. These were subsequently cut in fine pieces and a portion of the thoroughly mixed corn reserved for chemical examination.

The stages of growth at which the samples were taken are indicated in the table of analyses.

COMPOSITION OF FODDERS.

To a right appreciation of the results hereafter to be discussed a knowledge of the composition of fodder plants in general is necessary. On pages 116 and 117 of the Annual Report of the Experimental Farms for 1890 I have made some remarks on the origin, relative value and functions of the various constituents which make up the composition of fodders. To these pages the reader is therefore referred for such explanations regarding the terms albuminoids, fat, fibre, carbohydrates, &c., as he may require in order to understand the conclusions here stated.

INDIAN CORN AND ENSILAGE.

In the table that follows will be found in the several columns the data obtained on examination of the samples of Indian corn and ensilage. The two samples of corn ensilage were taken from the silos of the Central Experimental Farm on the dates recorded. Both were in an excellent state of preservation, and mildly acid. The silos were filled indiscriminately with the corn of many varieties grown on the farm, including those analysed.

An inspection of the figures and averages in the following table reveals the following facts:—

1. That there is a general similarity in the composition of the dry matter of all the corns examined, so that between those cut on the same date no great difference, except in one or two isolated cases, are to be noticed.

2. That the percentage of water in the corn fodder cut 26th August, was considerably greater than that in the samples taken 19th September. This means that the percentage of "dry matter" in the corn of the latter date exceeded that in the corn of 26th August. Thus one ton (2,000 lbs.) of the corn of the later period contains on an average 455 lbs. of dry matter, while the same quantity of that of earlier growth (August 26th) contains but 384·8 lbs.

3. That the percentage of ash in the dry matter decreased materially as the plant matured.

4. That the percentage of albuminoids had decreased slightly in the dry matter during the period of growth between 26th August and 19th September.

5. That the percentages of fat, fibre and carbohydrates had increased during the same period—the two former, however, not to any marked extent.

TABLE I.—ANALYSES of Indian Corn and Ensilage.

Name of Variety.	Stage of Growth.	Date of Cutting.	Water.	Dry Matter.	Percentage Composition of Dry Matter.				
					Ash.	Albuminoids.	Fat.	Fibre.	Carbohydrates.
Queen of the Prairie	Ears partially developed	Aug. 26	79·14	20·86	6·73	9·81	·72	26·72	56·02
Angel of Midnight	Tasselling	do 26	80 30	19·70	6·88	7·94	·94	26·92	57·32
Virginia Horsetooth	Ears not out, very high	do 26	83·04	16·96	8 27	9·06	1·03	26·34	55·30
Golden Beauty	do do	do 26	80·30	19·70	7·47	9·81	1·24	26·17	55·31
Early Adams	Ears partially developed	do 26	80·16	19·84	7·09	9·87	·98	27·87	54·19
Long White Flint	Ears not developed	do 26	80·64	19·36	6·29	7·94	1·48	27·87	56·42
Mammoth Southern	do	do 26	81·76	18·24	7·45	9·75	1·16	27·00	54·64
Average			80·76	19·24	7·17	9·17	1·08	26·98	55·60
Queen of the Prairie	In early milk	Sept. 19	75·22	24·78	5·70	7·50	1·05	26·40	59·35
Angel of Midnight	do	do 19	78·12	21·88	5·69	9·94	1·91	25·87	56·59
Virginia Horsetooth	Tasselling	do 19	78·67	21 33	6·31	9·81	1·49	27·60	54·79
Golden Beauty	In late milk	do 19	75·62	24·38	5·29	8·75	1·18	25·83	58·95
Early Adams	Some leaves brown ; stalks thin ; ears well filled.	do 19	76 12	23·88	3·96	6·25	1·32	28·75	59·72
Long White Flint	Ears partially developed	do 19	79·42	20·58	4·94	7·00	1·72	30 55	55·79
Mammoth Southern	do do	do 23	77·57	22·43	5·47	8·69	1·70	26·93	57·21
Average			77·25	22·75	5·33	8·28	1·45	27·36	57·58
Ensilage—									
Corn	Central Experimental Farm	Dec. 4	78·09	21·91	5·69	9·00	3·31	22·99	59·01
do	do do	Mar. 5	78·00	22·00	5·98	9 43	4·37	28·37	51·85

From these facts the following conclusions may be drawn :—

1. That a gradual increase of dry matter takes place until the corn plant arrives at its maturity. The concensus of opinion prevailing among the agricultural chemists of the United States is that the greatest amount of nourishment is in the plant about the time when the ear is glazing—after it has passed what is known as the "milk stage." At this period there is the largest yield of nutritive matter per acre, and if then cut and preserved most profit will accrue to the farmer. The stalks at the time of cutting should only be beginning to turn yellow near the ground. If the corn is left standing after this stage the amount of digestible albuminoids is lessened and the quantity of indigestible fibre increased—an example of this is seen in the analysis of the varieties Early Adams and Queen of the Prairie.

Since the composition of the dry matter in different varieties of Indian corn varies within such small limits, it becomes clear that the corn to grow for fodder purposes is that variety which yields the heaviest crop per acre, and comes to maturity in the locality in which the grower lives.

In support of the statements regarding the increase of food constituents during the latter stages of the growth of corn, I have taken the liberty to insert the following table copied from a Bulletin issued by the Experiment Station of Cornell University, New York, which gives the increased percentage of the nutritive constituents per acre, as derived from the work of four Experiment Stations in the United States.

TABLE II.—INCREASE in percentages of Nutritive Ingredients of Corn in maturing.

Year.	Place.	Variety.	Stage of Maturity.		Date.		Gains between First and Last Cutting.			
			First cutting.	Last cutting.	First cutting.	Last cutting.	Dry matter.	Albuminoids.	Fat.	Carbohydrates.
							Per cent.	Per cent.	Per cent.	Per cent.
1889..	Cornell Agricultural Experiment Station..	Pride of the North	Bloom	Mature	Aug. 2	Sept. 24	150	90	129	169
1888..	do do ..	do ..	do	Nearly mature	July 24	do 3	217	134	374	300
1889..	New York Agricultural Experiment Station	King Philip.	Tasselled..	Ripe	do 30	do 23	389	183	335	462
1887..	New Hampshire Agricultural Experiment Station......	Average 4 varieties	*Tasselled	*Glazed	Aug. 5	do 16	112	50	84	130
1889..	Pennsylvania Agricultural Experiment Station.....	do ..	†Tasselled	†Ripe & cured	......	......	155	.....	......	......
Average of all trials							205	114	230	265

*The average condition of the four, as near as may be.
†The actual condition of each, dates not given.

This enormous increase, in spite of lessened albuminoids and larger percentages of fibre, means that some tons per acre of digestible food is stored up in the corn plant during the last stages of its growth, and points undoubtedly and emphatically to the time for harvesting the fodder.

2. The decreased percentage of ash in the dry matter as the corn arrives at maturity shows that it is the young plant more particularly that absorbs the mineral constituents from the soil, and the same is no doubt true, though not to the same extent perhaps, as regards its nitrogen. This clearly advises that the previous tillage of the soil should be thorough, aud that during the early part of the season especially should the corn be well cultivated and kept free from weeds.

3. Attention has been called to the fact that the albuminoids decrease as the plant matures. This is, perhaps, but partially correct. The albuminoids are calculated by multiplying the total amount of nitrogen found by 6·25—as one part of nitrogen is equivalent to 6·25 parts of albuminoids. Now, as some of this nitrogen, more particularly in the young plant, exists in the condition of amides, it would be more accurate to state that the amount of nitrogen decreases during mature growth. It is considered that the nitrogen of the amides in the young plants is transformed into that of the more valuable albuminoids as ripeness approaches. Therefore, though the maturer plant may contain the less nitrogen, the loss may be more than compensated for in the increased percentage of true albuminoids. It is, therefore, the wisest policy to allow the corn to reach the glazed condition, especially when we remember the tremendous increase of dry matter, of which the albuminoids form a part, as the plant approaches maturity.

4. Fibre may be regarded as the framework of the plant, supporting the more tender tissues, and carrying by means of its tubes and vessels the nourishment elaborated by the roots and leaves. After it has been allowed to become dry and hard by over-ripeness, its digestibility is to a large degree impaired. Such change is usually accompanied by alteration in colour—the stem becoming yellow or brown. Want of light and room to grow often cause this discolouration prematurely.

Intimately connected with this matter of plant development is that of room—room for the roots and room for the stalks. For a rapid and generous growth of the plant, both are necessary. Plenty of loose soil is required for the roots and rootlets to pene-

trate, thus securing an ample supply of nitrogenous and mineral matter. Sunlight and air are essentials to a large development of the carbohydrates. Crowding due to over-thick seeding will result in a diminished yield per acre.

DIGESTIBLE MATTER IN GREEN FODDER.

In table III will be found the weight in pounds of the digestible constituents per ton of the green fodder and ensilage. These weights have been calculated from the percentage composition of the corns, using the following co-efficients of digestion:—

Albuminoids, 73.	Fat, 75.
Fibre, 72.	Carbohydrates, 67.

Referring to the averages given in this table, it will be noticed that one ton of green fodder cut August 26th contains 256·31 lbs., while one ton of that cut September 9th contains 297·72 lbs. of digestible matter, an increase of 41½ lbs. This is principally due to the lessened percentage of water in the maturer corn.

It is not in one class of ingredients alone that this augmentation has taken place, though, as might have been expected from what has already been said about decreased nitrogen in the riper corn, the albuminoids have not increased in the same ratio as the other nutrients.

Data has already been quoted (table II) to show that the yield per acre of food constituents increases in the ripening corn. The results in table III prove that weight for weight this riper corn is the more valuable fodder.

TABLE III.—DIGESTIBLE Matter and Nutritive Ratio.

Name of Variety.	Stage of Growth.	Date of Cutting.	Pounds of Digestible Matter per Ton of Green Fodder.					Nutritive Ratio.
			Albuminoids.	Fat.	Fibre.	Carbohydrates.	Total Digestible Matter.	
Queen of the Prairie	Ears partially developed	Aug. 26	29·88	2·25	80·22	156·51	268·86	1 : 8·1
Angel of Midnight	Tasselling	do 26	22·83	2·78	76·36	151·19	253·16	1 : 10·3
Virginia Horsetooth	Ears not out; very high	do 26	22·42	2·62	80·28	125·60	230·92	1 : 9·5
Golden Beauty	do do	do 26	28·21	3·67	74·24	146·01	252·13	1 : 8·1
Early Adams	Ears partially developed	do 26	28·61	2·92	79·66	144·14	255·33	1 : 8·1
Long White Flint	Ears not developed	do 26	22·43	4·29	78·37	146·29	251·38	1 : 10·5
Mammoth Southern	do do	do 26	24·66	3·17	70·96	133·62	232·41	1 : 8·6
Average			25·58	3·10	77·16	143·91	256·31	1 : 9·0
Queen of the Prairie	In early milk	Sept. 19	27·10	3·89	94·09	196·83	321·91	1 : 11·1
Angel of Midnight	do	do 19	31·78	6·28	81·58	166·07	285·71	1 : 8·3
Virginia Horsetooth	Tasselling	do 19	30·54	4·77	84·88	156·76	276·95	1 : 8·3
Golden Beauty	In late milk	do 19	31·17	4·32	90·76	192·75	319·00	1 : 9·4
Early Adams	Cobs ripe; some leaves brown; stalks thin; ears well filled	do 19	21·80	4·73	98·94	191·26	316·72	1 : 13·9
Long White Flint	Ears partially developed	do 19	21·05	5·32	90·63	154·00	271·00	1 : 12·2
Mammoth Southern	do do	do 23	28·42	5·71	86·87	171·72	292·72	1 : 9·6
Average			27·41	5·00	89·68	175·77	297·72	1 : 10·4
Ensilage—								
Corn	Central Experimental Farm	Dec. 4	28·78	10·87	72·50	173·17	285·32	1 : 9·5
do	do do	Mar. 5	30·29	14·42	89·88	152·85	287·44	1 : 9·2

ENSILAGE.

The *exact* feeding value of corn ensilage, as compared with that of corn preserved in the dry condition, has as yet not been positively ascertained. There appears to be plenty of evidence on the one hand to support the superiority of dry corn fodder, while on the other hand, from different sources, there seems to be proof positive that the ensilage is the more nutritious of the two. In the process of ensiling a portion of the true albuminoids become converted into compounds supposed to have a lower feeding value, and some of the carbohydrates are transformed into organic acids, while in preserving in the dry condition much of the fibre is rendered indigestible. The silo forms a ready and cheap means of preserving in small compass a large quantity of corn, and when the proper precautions are taken in constructing the silo and protecting the ensilage, there can be but little doubt that this method of storing fodder is an economical one.

Chemistry teaches that the one great principle to be remembered and practised in preserving by means of the silo is *exclusion of air.* The more air-tight the walls of the silo, the closer the cut corn is packed, and the more completely it is protected from the air, the better will the ensilage be. Access of air causes fermentation, development of acid, and finally, decay.

As the samples of corn ensilage were not composed wholly of the varieties of corn analysed, no strict comparison can be drawn between their composition and that of the corns examined. The percentage of dry matter is slightly lower, and that of the ash somewhat higher than in the corn of September 19th. The albuminoids do not seem to have suffered by the process—though possibly to some extent albuminoids here represent amides and other nitrogenous compounds. The development of organic acids in fermentation has increased the figures that represent the percentage of fat, since in the process of analysis they are determined largely with the latter ingredient.

From the present analyses, and using the same co-efficients of digestion as for corn fodder, it appears that one ton of corn ensilage contains somewhat less (about 10 lbs.) of digestible nutrients than the same weight of the corn cut September 9th. (See table III.)

We may, therefore, conclude that between well-preserved ensilage and mature green fodder there exists but little difference in feeding value.

221.

BULLETIN No. 13.

REPORT

ON THE

PROGRESS OF THE WORK

OF THE

EXPERIMENTAL FARMS

OF THE

DOMINION OF CANADA.

EVIDENCE GIVEN BEFORE THE

COMMITTEE ON AGRICULTURE AND COLONIZATION

OF THE

HOUSE OF COMMONS,

JUNE 2nd, 1891.

BY

WILLIAM SAUNDERS,
Director of Experimental Farms.

REPORT

ON THE

PROGRESS OF THE WORK

OF THE

EXPERIMENTAL FARMS

BY

WM. SAUNDERS.

Director Dominion Experimental Farms.

MR. CHAIRMAN AND GENTLEMEN OF THE COMMITTEE ON AGRICULTURE AND COLONIZATION.

It affords me very much pleasure to be privileged again to come before you to render some account of my stewardship and to indicate some of the points of interest connected with the work of the Experimental Farms which I have the honour to direct, under instruction of the Minister of Agriculture. You will find in the annual report which is before you a very full account of the work which was carried on last year at each of the five farms which have been established by the Government, but as many of you may have had but little opportunity of looking over this report, you will pardon me if I refer to a few points contained in it, with the view of showing the progress made.

DISTRIBUTION OF SEED GRAIN.

The distribution of seed grain for test is held to be one of the most important branches of work carried on at the Experimental Farm. The great interest which has been awakened in this subject far exceeds our anticipations. Last year we had, as

you will find by the report, requests for samples of grain to the extent of 12,353. These came from 5,896 different farmers, and these having been supplied, would not, in most cases, receive samples this year, we have, however, had applications in 1891 from 4,388 additional parties, which has involved the further distribution of 11,230 3-lb. samples, or between 16 and 17 tons of seed grain. The following are the varieties of grain which have been sent out with the number of 3-lb. bags of each. Oats, 4,702 ; barley, 3,003 ; wheat, 2,091 ; peas, 1,089 ; rye and corn, 113 ; and potatoes 232. Many gratifying reports have been received from the farmers who have participated in this distribution, and in the annual report you will find the opinions of some of them under the heading "Distribution of Seed Grain." The Ladoga wheat, which was one of the first varieties of grain distributed in this way four years ago, is growing very much in favour in the North-West. During the past year the inquiries for that wheat have been very numerous from settlers who desired to purchase it in quantities, and all we could supply from the Experimental Farms has been disposed of in that manner. A farmer at Griswold, Manitoba, Mr. Hanna, who received a 3-lb sample four years ago from the Experimental Farm, wrote to me during the winter to say that he now had 1,500 bushels of this wheat from that sample, for which he was finding a ready demand for seed at a higher price than he could get for ordinary grain. I have with me, Mr. Chairman, a sample of Ladoga wheat which was grown at Prince Albert, in 1890, to which I would like to call special attention, as I think it is the finest sample of spring wheat I have ever seen. It weighs 66½ lbs. to the bushel, 6½ lbs. over the standard, and is very uniform in size and of the highest quality. Specimens of this grain have been sent to prominent millers and grain-buyers in Canada, the United States and Great Britain, and they all agree in the opinion that it is one of the finest samples of spring wheat that they have ever seen. This being grown so far north as Prince Albert in such perfection seems to indicate that there is a large area in that district for profitable wheat culture, and which in all probability this variety will help to fill.

Mr. E. Plaxton sent me this sample from Prince Albert. He received a 3-lb. bag three years ago, and last year had a crop of 172 bushels, of which he says this is a fair sample. I mention this to show that these samples of grain, which may not at first awaken very much

interest or command general attention, will in time find their proper places all over the country. Some localities will be found especially adapted for their cultivation, and others again where they are of little or no value. Ladoga wheat in Ontario has not been generally successful, except in some of the northern districts; it has suffered more than other sorts from rust, and does not seem to have the power of adapting itself to the climate of western Ontario. It does well in the more northern parts of this Province, in Quebec and in some parts of the Maritime Provinces. Nowhere, however, has it done so well as in the drier districts of the North-West, where very little is known of rust on any varieties of wheat. There it seems to be at home, and has been able to adapt itself to such conditions of climate as exist in a way that was scarcely anticipated. At the outset there were some doubts as to whether this wheat had the requisite quality for a North-West wheat. It was said to be a little thick in the skin and dark in colour, but in these particulars it has improved by cultivation since its introduction into the North-West. The skin has become thinner, the grain is brighter, and now it is usually graded as of first quality by those most competent to judge.

TESTS OF GRAIN, ROOTS, &C.

You will also find in the annual report full particulars of a large number of tests of different varieties of grain, roots, potatoes and other farm products, which have been grown on the Central Experimental Farm. This work is being continued during the present season, and I hope to have the pleasure of visits from as many members of the committee as can find it convenient, as the season goes on, so that all may have the opportunity of judging for themselves as to the growth and productiveness of many of these varieties. There are at the present time growing on the Experimental Farm 69 named varieties of wheat; 61 of oats; 29 of 2-rowed barley; 22 of 6-rowed barley; or 181 varieties of cereals in all. To these must be added the new crosses and hybrids which have been originated on the Central Experimental Farm. I mentioned to you, I think, last year, that some work had been done in that direction on the farm—a class of work which I think is most important for this country. It consists in bringing together different varieties of grain, in the same way as you bring together different strains of cattle, and by cross fertilizing, produc-

ing new sorts, which have more or less of the impress of both the varieties used as parents. At the time I had the honour of meeting you last year we had produced 38 varieties. During the summer of last year, 76 others were originated in this manner, so that we now have 114 varieties of grain growing on the Experimental Farm which are entirely new. Most of these cover but small plots; some of them are only single plants as yet, but among them are some promising sorts. Ninety of these are wheat; 16, barley; and 8, oats.

EXPERIMENTS WITH FERTILIZERS.

The special tests with fertilizers, to which I made a brief reference last year, have been continued; 105 plots, of one-tenth of an acre each, are devoted to this special work, where the same fertilizers are applied each season, with test-plots not fertilized amongst them for comparison. The same varieties of grain are grown on these plots every year, and it is hoped that we shall thus be able, in the course of a few years, to ascertain the effects of each fertilizer or group of fertilizers on the crops under treatment.

TESTING THE VITALITY OF SEED GRAIN.

The tests of grain as to vitality have also been continued during this spring. Last year there were received for test 1,245 samples, many of them coming from farmers residing in distant parts of the Dominion, who desired to know if the grain they held in stock for seed was suitable for that purpose. A glass structure, known as the seed-testing house, has been built specially for this work. Those of you who have had practical dealings with farm work will know that sometimes in the harvest season the weather is unfavourable, and if the grain is frosted, or is stored in a damp condition, its vitality is very often seriously injured, and it becomes a matter of importance then for the farmer to know just what percentage of this grain will germinate. Every farmer in the Dominion has the privilege of sending to the Farm samples of grain through the mail, free of postage; they are tested and the information is given free of charge with as little delay as possible. This season, between the 1st of January and seeding time, 2,757 samples were tested and reported on.

EXPERIMENTAL FARM CROPS.

More than 300 acres of land are now under crop at the Central Farm, including wheat, 20 acres; barley, 45; oats, 90; rye, 15; peas, 20; corn, 20; mixed grain, 35; roots, 16; potatoes, 5; and meadow, 40. In addition to the 181 varieties of named cereals to which I have already referred as now growing on this land, there are 69 varieties of corn, 27 of peas, 21 of beans, 111 of named potatoes, and 153 varieties of seedling potatoes—264 in all. There are also 28 varieties of turnips, 14 of mangels, 24 of carrots, and 13 of sugar beets. These facts will enable you to form some idea of the extent of the experimental work going on. Notes are taken of all these varieties as to their earliness, productiveness, etc., not only here, but of many of them at the branch experimental farms also, and these notes are compared at the close of the season. From the information thus gathered a tolerably accurate opinion can be formed as to how far they are likely to be useful to the farmers residing in the different Provinces of this country.

PROGRESS IN STOCK, DAIRYING, &C.

Some additions have also been made to the stock on the Central Experimental Farm. A few Durhams of good milking families have been added to the herd, also some Devons and Galloways; eight Quebec Jerseys or Canadian cows have been selected in the eastern part of Quebec, these being good representatives of that particular family of cows, the descendants of the importations from Normandy by the early French settlers. These cows are promising as milkers, and give rich milk. Feeding experiments are being tried with the different breeds, and experiments also in crossing. Eight additional grade cows have been purchased for the dairy, which brings the total number of cattle on the Farm at present to 87. There are 35 pure-bred cows, 11 grade cows, 7 pure-bred bulls and 34 young animals. During the year an experimental dairy building has been erected, supplied with the necessary apparatus for carrying on butter-making in the most approved manner. There is a store-room also, in this building, for curing cheese, where some of the products of the experimental dairy stations, which are now being organized by Professor Robertson, will be stored. Some of these products will be sent to the Central Farm, in order

to ascertain the best methods of curing, and also for the purpose of comparing the cheese made in the different Provinces, so that defects in quality may be discovered and remedied, with the view of bringing the whole to a uniform standard as a first-class product, so that it may command the best prices in the markets of Europe.

A piggery has been built and stocked with four pure breeds of pigs. Six pens were also filled with grade animals, which have been submitted to feeding tests during the winter. Most of these have lately been disposed of, as the experiments are concluded. An engine-house has also been erected, with shafting running the full length of the barn, so that conveniences may be available for threshing, also for grinding and cutting food wherever required. The planting of shelter belts of trees around the Farm is nearly completed, over 3,000 trees having been planted this season. The objects in planting these are to afford shelter and also demonstrate the rate of growth of the different varieties in this part of the Dominion.

CORRESPONDENCE, DISTRIBUTION OF BULLETINS, &C.

Perhaps no feature of the Farm work will convey a clearer idea as to the interest which farmers are taking in what is going on than the increase in the correspondence between the farmers of the country and the Experimental Farm. You all know that farmers as a class are not fond of letter-writing, and with many a man the desire for information must be very strong to induce him to write a letter. The letters received at the Central Experimental Farm in 1889 numbered 6,864, whereas during the same period in 1890 the number was 17,539, an increase of nearly three-fold. The number of bulletins and reports sent out in response to applications, in 1889, amounted to 41,584; last year they numbered 218,129, more than four times as many as in the previous year. The names on the permanent mailing list, which have been put on by special request, number now over 21,000, showing that the reports and bulletins are in great demand. The early editions were only 5,000; this was soon increased to 10,000, then to 20,000, and now we are issuing 25,000. One of the honourable gentlemen present asked whether these bulletins were published monthly. They are not published at any stated time, but as soon as any subject has been sufficiently worked up to permit of such conclusions as are likely

to be valuable to the farmers of this country a bulletin is issued. During the past month two bulletins have been printed, and sometimes several months will pass without an issue.

HORTICULTURAL WORK.

The Horticultural Department at the Central Farm, under Mr. John Craig, is making good progress, and a large number of additions have been made to the fruit trees. There are now on the Experimental Farm over 500 varieties of large fruits, including apples, pears, plums and cherries; also, 343 varieties of small fruits, such as grapes, raspberries, strawberries, currants and gooseberries. Besides these, there are several hundred sorts of new fruits, which have been produced either by selection or by crossing. The question of vegetables has also been taken up on a rather large scale during the past year, and is again under process of test this season. Last year 51 varieties of cabbage were tested, 57 of tomatoes, 50 of peas, 31 of cauliflower, 32 of lettuce and celery, with smaller numbers of other vegetables. The different qualities of many of these sorts are taken note of and the results submitted in the annual report. In the horticultural branch experiments have also been carried on with regard to the treatment of apple scab. You all know that the black scab on apples lessens the value of a large quantity of the fruit produced in Ontario, Quebec and the Maritime Provinces. It is believed that this disease can be prevented or checked by the use of fungicides if applied at the proper time. Experiments have been conducted to determine the best time to apply such remedies, the strength of the mixtures which should be used and the most economical and convenient methods of making the application. Bulletin No. 10 contains the results of this special work on apple scab.

FORESTRY.

The demands from Manitoba and the North-West for samples of forest trees for experimental planting on the plains has been very great. A little over a year ago, under instruction of the Minister of Agriculture, an announcement was made that the Experimental Farm would make a limited distribution of young forest trees for test on the Western Plains. One hundred thousand trees had been secured and arrangements made to put those up in 1,000 packages o-

100 trees each, thinking this would be an ample supply; but within five or six weeks after the announcement was made 2,600 applications were received. The requests were complied with, as far as the material would allow, and a circular was sent to those who did not receive any, stating that if any further distribution was decided on their names would be considered first. By instruction of the Minister, preparations were made to distribute 200,000 more in the spring of 1891, taking first the names of those who applied last year. This has been done, and about 400 additional applicants supplied. By these means it is hoped that at some 3,000 points small groves of trees will be established, which, in the course of a few years, will begin to produce seed themselves. We shall thus have many additional points at which the seeds of trees will be obtainable for further distribution and planting as one of the results of the work which has been carried on during the past two years at the Experimental Farm.

Besides sending to private individuals, larger packages have been sent to the Indian agencies, Mounted Police stations and other public institutions throughout the North-West, and instructions have been given to the heads of these departments to take special care of the trees, and report to the Experimental Farm from time to time as to their success. The Canadian Pacific Railway having established twenty-five experimental gardens along their line between Moose Jaw and Calgary, a package was sent last year to each of these gardens for test, and this year a second supply has been forwarded. It is believed that these distributions will have the effect of stimulating tree-planting and of awakening a greater interest in this subject, so important to the settlers in the North-West. The experiments carried on at Indian Head and Brandon on the Experimental Farms in tree-planting have only been partially successful. Experience has shown that for successful forest planting in the North-West we must begin with the native trees, and if young trees be raised from the seed of the ash-leaved maple, white elm and ash, gathered in the North-West, such trees will be very much hardier than if grown from seed ripened in Ontario, Quebec or the Eastern States. The young trees grown from eastern seed are often killed back from one-half to two-thirds of their growth the first winter, and it takes them several years to gain that degree of hardiness which trees grown from seed collected in the North-West pos-

sess at the start. Last year tree-seeds were plentiful, and arrangements were made, when in the North-West, to have a large quantity collected in the Qu'Appelle valley and about the Brandon Hills, Oak Lake and at other suitable points in Manitoba and the Territories. Efforts have been made for the past two years to obtain tree-seeds there in quantities, but with little success ; but last season, through the energy of our Superintendents, Mr. S. A. Bedford and Mr. A. Mackay, who employed half-breeds, Indians and settlers to collect them, we secured in the course of five or six weeks, about three tons of seed. This gratifying success has enabled us to plant out several acres of tree-seeds on each of the Experimental Farms, which will in all probability produce several million trees, and has given the material for a general distribution, through the mail, of about 6,000 bags of tree-seeds to the settlers. This, added to the distribution of young trees, will, I believe, give tree-planting in the North-West a very considerable start, and the material sent out will, if taken care of, certainly be of great value to the country.

CHEMICAL WORK.

In the chemical branch, conducted by Mr. F. T. Shutt, excellent progress has also been made. A number of samples of soil from the different Provinces, including alkaline soils from the North-West, also heavy soils from the far western plains, have been analysed, with a view to determine the relative fertility of these different soils. Similar work has been done on samples of muck, peat, and muds from the Eastern Provinces, for the purpose of finding out how far these can be used as fertilizers., Some 50 or 60 samples of sugar-beets grown at different points in Ontario and the other Provinces have also been analysed, and the proportion of sugar contained in each ascertained. The results of most of this work will be found in the annual report for the past year. Many examinations of milk of the different breeds of cattle have been made, for the purpose of determining which are the richest and how far the quantity of butter can be influenced by change of feed. Mr. Shutt has also analysed 52 varieties of grasses, including a large number from the North-West, for the purpose of ascertaining whether any of the uncultivated sorts contain a larger proportion of nutriment than the grasses usually in cultivation. He has also tested many fodder plants, including corn cut at diffemt stages of growth, also

ensilage, and such other miscellaneous products as have been thought to be of sufficient value to the whole country to warrant the conducting of these analyses. It is necessary to use some discretion in selecting material to be analysed, so as to undertake that only which is of the most general importance. Wherever there is any likelihood of such work being conducive to the general public good, then the labour and expense connected with it is not allowed to stand in the way of its being carried out.

ENTOMOLOGICAL AND BOTANICAL WORK.

The Entomologist and Botanist, Mr. James Fletcher, has also been doing very useful work. He has experimented to a large extent on injurious insects, especially on those which attack the more important crops of the country. You will find a number of important facts contained in his report in the last annual issue which is before you. Much of his time is necessarily occupied in giving information to correspondents who apply to him in cases of special insect invasion. Bulletin No. 11, on Injurious Insects, which has just been issued, and copies of which have been brought here this morning for distribution, contains some recommendations Mr. Fletcher has been making for the prevention of damage by some of these common insects to the farm and the garden.

In the botanical department a large number of experiments have been conducted with grasses likely to be useful to the different Provinces of the Dominion. Nearly 150 varieties of these are now under test for hardiness, productiveness and general usefulness for agricultural purposes. A number of applications have been received at the Farm for samples of the seed of grasses which are likely to be useful in the different parts of the Dominion, and in response to these requests 135 packages were sent out this spring, each containing from 15 to 20 varieties of grasses. These correspondents have engaged to test them and report the results of those tests.

POULTRY.

In the poultry house, which is under the management of Mr. Gilbert, experiments have been carried on as to the management of fowls in all stages of their growth, also on diseases of poultry and the preservation of eggs.

EXPERIMENTAL FARM, NAPPAN, N.S.

Satisfactory progress has also been made at the branch Experimental Farms. At the Nappan Farm, in Nova Scotia, under the efficient management of Col. Wm. M. Blair—a farm which serves the purposes of the Maritime Provinces—a large number of varieties of wheat, oats, barley, corn, field roots and potatoes have been tested during the past year. Special tests have also been made with artificial fertilizers and barn-yard manure. The barn and stables have been completed and partly stocked with Holsteins, Ayrshires, milking strains of Durham cattle. and with grades. The orchards at the Nappan Farm contain a large number of varieties of fruit trees, which have succeeded very well there. A great many farmers belonging to the Maritime Provinces visit the farm every season, and from the comments which these visitors make it would appear that they are highly pleased with the progress of the work going on in that district.

EXPERIMENTAL FARM, BRANDON.

The Brandon Farm is also doing good service, under the superintendence of Mr. S. A. Bedford, who is highly spoken of by all those who come in contact with him. A very large number of farmers visit that farm every year, Brandon being a railway centre and convenient of access. The farm is only a mile from the city, which makes it easily reached by visitors. The increasing interest manifested by the farmers in Manitoba in this work is very encouraging. Last year, when I visited that Province, I went to the Icelandic settlement, about forty miles from Brandon, to see the progress the Icelanders were making. Whilst talking to one of their leading men, he said: "I went up to see your Experimental Farm at Brandon last year with a number of my people. We never undertook a more profitable journey. We learned more there in connection with the varieties of grain that are useful for this country, the sorts of fodder desirable to grow for winter food for stock, and a great many other subjects, in one day, than we have ever had the opportunity of doing before." He also said: "We are going again next year, and intend to spend three or four days there, and bring away all the information we can get." That is one of the evidences of the useful character of the practical work which is being carried on at that institution, and the estimate which is being

formed of it by the farmers in the neighbourhood. The different methods of preparing the soil for crops have been tried there. The ordinary drill, the press drill and the broadcast seeder are all used. A number of varieties of fodder plants are being grown, which promise well for winter food for stock, including corn, mixtures of different kinds of grain, millets, Hungarian grass and rye. These have all been tested with a view of finding out the most profitable plants to grow as food for cattle. Many farmers who have seen the results of these tests on the Brandon Farm have begun experiments for themselves, and a very general interest has been awakened in the subject. The tests of fruit trees and vines are also closely watched, and much instruction is given, and many farmers have thus been saved from unprofitable investments. It is very common for a settler when he goes to the North-West and undertakes the planting of trees about a homestead to think of the trees he planted in Ontario, Quebec or elsewhere, and he frequently incurs much expense in getting such trees for his new home, never thinking that they are unsuited to the climate. The result is, that many thousands of dollars have been uselessly spent in that way for trees which have died the first winter. Such results are apt to discourage men from making future attempts. If we can demonstrate by practical tests that certain trees will succeed there, while certain others will not, we shall be able to save the farmers a good deal of money, by encouraging them to test only such as are likely to be successful. The barn and stables at Brandon are now completed, and it is hoped that during the coming summer such dairy stock as is most likely to be useful for that district will be introduced there.

EXPERIMENTAL FARM, INDIAN HEAD, N.W.T.

At Indian Head, nearly 200 miles further west, similar experiments with grain are being carried on. This farm is in charge of Mr. A. Mackay, a practical farmer of large experience, whose work is highly appreciated by all. During the past year 47 varieties of wheat, 32 of barley and 16 of oats were tested, as well as a number of varieties of Indian corn. The Indian corn has not thus far been found to succeed as well at Indian Head as at Brandon; the growth is neither so large nor so well matured. Spring rye is the most promising crop there for the winter

feeding of stock, and when cut green it makes excellent hay. Last year this crop yielded, at Indian Head, from 2 to 3 tons per acre. Spring rye has been sown at different periods, to ascertain when it should be seeded in order to produce the greatest weight of crop. Not many of the fruit trees tested have been found to stand the climate there, but there are a few that give some promise of success. In forest trees, those grown from the native seed are the only varieties that have yet succeeded to our satisfaction. A number of others are doing fairly well, but have been injured more or less by the climate. Stock has also been supplied at Indian Head. There are now on that farm 5 Durhams, 4 Ayrshires, 4 Holsteins, 3 Polled Angus and 11 grades, the latter purchased in the North-West. The services of the bulls of the pure-breeds are useful to the farmers, as good stock is scarce in that country.

EXPERIMENTAL FARM, AGASSIZ, B.C.

The farm at Agassiz, British Columbia, was the last established. In August, 1889, the Superintendent, Mr. Thos. A. Sharpe, wasplaced in charge, and since then the work under his energetic direction has gone on rapidly, and about 90 acres of land have been brought under cultivation. There are altogether 300 acres in that farm, and already a large number of experiments with grain and other farm crops have been carried on there, as at the other farms referred to. A considerable interest has been awakened among the farmers of British Columbia in this farm, and the number of visitors is steadily increasing. The farm is conveniently situated for visitors, from the fact that the train going west arrives there about 10:30 in the morning and that going east about 3 o'clock in the afternoon. The residence for the Superintendent is nearly completed, and will soon be ready for occupation. It is expected that during the summer a barn will be built to accommodate the horses and some stock. At present we have a very good Shorthorn bull there, and two pure-bred Shorthorn cows, to which other useful breeds will soon be added. The climate is specially adapted for the production of fruits. A large orchard, containing 400 varieties of fruit trees, has been planted, also 200 varieties of small fruits. Some of the plums, nectarines and peaches are already beginning to fruit, and the trees are making most promising growth. Over 400 varieties of forest trees and ornamental shrubs have also been

introduced, including a large number of hardwood trees from the east, a class of timber in which that country is very deficient. If we can establish the walnut, hickory, elm and other hardwoods, and show that they can be profitably grown, it will be a great benefit to that country, by furnishing suitable material in the future for manufactures which will spring up at different points. The clearing of the land is going on steadily, and it is hoped that in a short time that farm will be as well advanced as any of the others. Poultry is being tested at Agassiz, as the raising of poultry and the production of eggs are very important in British Columbia. At the present time large quantities of these products are imported from the Eastern Provinces.

EXHIBITIONS AND SALES OF GRAIN.

At all the Experimental Farms preparations were made last year and carried out for attending agricultural exhibitions in the several Provinces, and in this way the products of the farms were brought under the notice and observation of a very large number of the farmers who attend such fairs, and a knowledge of the work in progress was thus widely disseminated. A quantity of seed grain was also sent out in small packages or sold by the bushel from each of the branch farms, the price charged being a small advance on the ordinary market price of such grain, so as to partly cover the cost of extra cleaning, etc. Some very useful sorts have thus been disseminated among several hundred farmers, in quantities of 2 bushels or more to each, and it is highly probable that some of these will soon become the leading sorts in cultivation in the several Provinces of the Dominion.

222.

CENTRAL EXPERIMENTAL FARM.

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DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - CANADA.

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BULLETIN No. 14.

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THE HORN-FLY.

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SEPTEMBER, 1892.

To the Honourable
The Minister of Agriculture.

SIR,—I have the honour to submit to you herewith Bulletin 14 of the Central Experimental Farm which has been prepared at my request by Mr. James Fletcher, the Entomologist and Botanist of the Dominion Experimental Farms. It treats of the "Cattle Horn-fly," a new insect pest which has lately found its way into Canada from the United States. Many letters of enquiry have of late been received at the Central Experimental Farm in reference to this insect, and the injury resulting from its attacks has awakened a general interest in the subject among the farmers of Ontario and Quebec. The concise and complete account given in this Bulletin of the life history and habits of this insect and of the remedies which have been found most efficacious, will, it is hoped, give to the farmers of Canada the information needed in reference to this important subject.

I have the honour to be,
Your obedient servant,
WM. SAUNDERS,
Director Experimental Farms.

Central Experimental Farm.

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DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - - - CANADA.

THE CATTLE HORN-FLY.

(*Hæmatobia serrata*, Robineau-Desvoidy.)

By James Fletcher, F.L.S., F.R.S.C.

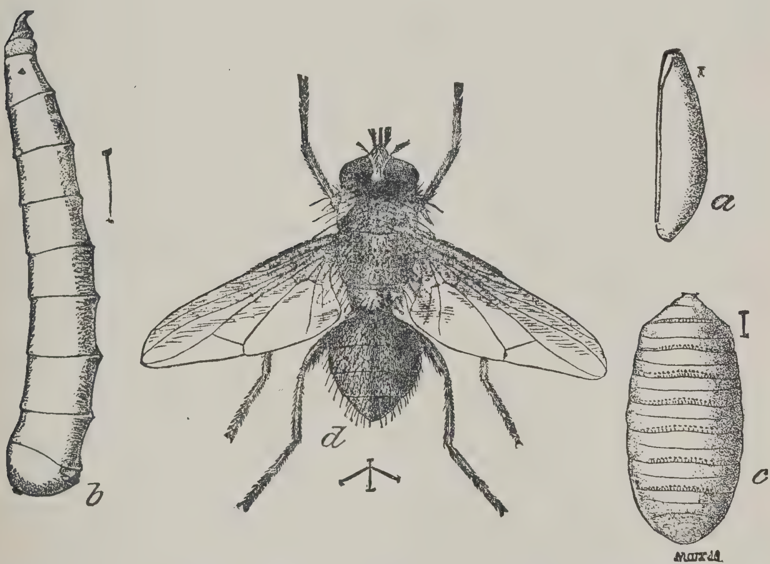

Fig. 1. The Horn-Fly. *a*, Egg; *b*, maggot; *c*, puparium; *d*, adult fly in biting position—all enlarged. (Figures kindly lent by the United States Entomologist.)

Considerable anxiety has been evinced by stock-owners in the Provinces of Ontario and Quebec, concerning the sudden appearance upon their cattle of enormous numbers of a small blackish fly which irritates the animals so much with its bite and disturbs them so constantly that they fall off rapidly both in flesh and yield of milk.

This is the so-called "Horn-Fly" which has attracted much attention in the United States for the last three years. It is a European pest which was first brought to the notice of the U. S. Division of Entomology in September, 1887, and was probably imported with cattle from Europe, where it has been known since 1830.

In 1889, its complete life-history was worked out by Prof. Riley and his assistants Messrs. L. O. Howard and C. L. Marlatt. This was published in "Insect Life" vol. II., p. 93-103 and in the Annual Reports of the U. S. Entomologist for 1889 and 1890.

These investigations were so thorough that there was little left for later observers to discover.

Prof. J. B. Smith, of New Jersey, also worked up the life-history independently, at the same time, and published an account of his work in Bulletin 62 of the New Jersey Agricultural Experiment Station.

Fig. 1, above, shows this new pest much enlarged in all its different stages of egg, maggot, pupa-case and perfect insect. (The hair-lines by the side of the figures show the real size.) Fig. 2 illustrates the peculiar habit this insect has, of resting in large numbers, on the base of the horns, which has given rise to its popular name. Both of these figures have been kindly lent by the U. S. Entomologist and are the same as were used in the article in Insect Life above referred to.

The advent of this insect into Canada was first brought to my notice by Mr. Elmer Lick, of Oshawa, Ont., on July 30th last, when he stated that it had appeared in large numbers in that section of country and was causing considerable alarm. Since that date I have received specimens and enquiries from localities ranging from the extreme west of Ontario to Boucherville, P.Q., some few miles east of Montreal. In all cases farmers seem to be thoroughly aroused and to appreciate the losses they may suffer by neglecting this pest. Exaggerated statements of losses, and injuries to the animals which are quite impossible, have received free and extensive circulation by word of mouth, and through the newspapers. Cows are inaccurately said to have been killed by the flies, which, it is alleged, lay their eggs either on the horns into which the maggots bore and then penetrate the brain, or "in holes which they eat through the hide, lay eggs therein, which hatch out in

large numbers and proceed with their boring operations until the vital portions of the cow are touched and death ensues."

None of these statements are founded on fact. As stated above, the complete life-history has been worked out. I had the good fortune to be in Washington, staying with Mr. Howard, in August, 1889, and was courteously permitted to join in his investigation of this matter. Together we visited some of the infested stock-farms in Virginia and secured living flies and eggs from which, later on, the perfect insects were reared.

The life-history is briefly as follows :—

The eggs (Fig. 1. *a.*) are laid singly on the freshly-dropped dung of cattle, chiefly during the warmer hours of the day. They are $\frac{1}{20}$ of an inch in length, brown in colour from the very first and from this fact are not easily seen where laid. The young maggots hatch from the eggs in less than twenty-four hours, and at once burrow a short distance beneath the surface of the dung. Here they remain until full-grown, feeding on the liquid portions of the manure. This is their only food and all stories about their boring into the horns, brains or flesh of living animals are untrue. When the maggots are full-grown, which takes about a week, they are $\frac{3}{8}$ of an inch in length, shaped as shown at Fig. 1. *b*, and are of a dirty white colour. They descend a short distance into the ground to pupate, and the dark-brown pupa-cases (Fig. 1. *c*) are $\frac{1}{8}$ of an inch in length. During the hot weather of summer the pupal state lasts only four or five days, but the last brood passes the winter in this condition a short distance beneath the surface of the ground, and the flies emerge the following spring. The perfect insect (Fig. 1. *d.* male) is shaped much like the common cattle-fly* or the house-fly ; but it is smaller, being only $\frac{1}{6}$ of an inch in length, that is, about one-third the size of those insects.

The colour of the Horn-fly is dark gray with a yellowish sheen, and the body is covered with black bristles. The head consists almost entirely of the dark-red silvery-edged eyes, but bears on its lower surface the black dagger-shaped tongue which is the cause of so much torture to cattle. When not in use this is carried projecting forward in front of the head.

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*NOTE —*Stomoxys calcitrans*, sometimes called the "Biting House-fly," from its annoying bite and frequent occurrence in houses. The true House-fly (*Musca domestica*) never bites having only a sucking tongue.

This pest will be at once distinguished from the ordinary cattle-fly by its smaller size, greater activity and the characteristic habit of gathering in clusters upon the horns of cattle, particularly upon the upper side. When very abundant the flies form a more or less complete ring around the horn extending sometimes from two to four inches from the base towards the tip, as shown in figure 2.

Fig. 2. Cow-horn showing band of resting flies—reduced.

The clustering upon the horns seems to be peculiar to this species, for where the common Cattle-fly occurs with it in large numbers upon the same animals, I have never found specimens in the thick clusters upon the horns. Neither does the Horn-fly, like the Cattle-fly, bite horses and other animals ; but seems to confine its attacks to cattle. It may not be amiss to mention here that no injury whatever results from this habit of gathering on the horns, the flies merely resorting to the horns as a resting place from which they cannot be easily dislodged by the animal. They also congregate on the neck and at the base of the tail. The flies assume two characteristic positions, one while feeding when the wings are slightly elevated and held out from the body, as shown in fig. 1. *d.* the other while resting, when the wings lie nearly flat down the back, with the tips only slightly separated. It is in this resting position that they are always found on the horns.

Cattle of all breeds are subject to the attacks of this pest, but there is very great difference in the susceptibility to injury of various breeds and individual animals according to their temperament and the texture of their skins. While feeding, the flies work their way down through the hairs so as to reach the skin of their victim, but they are extremely agile and quickly take flight at the

slightest disturbance. The bites seem to produce great irritation and sores are frequently formed on the bodies of animals by their rubbing themselves against trees and other objects or by licking bitten places where the irritation cannot be allayed by rubbing, as inside the thighs and around the udder.

It is in the perfect state only that this insect is troublesome to stock ; but it appears early in spring and lasts the whole season, successive broods following each other rapidly throughout the summer. Mr. Howard found that from ten to seventeen days, say two weeks, was about the time required from the laying of the egg to the appearance of the fly, and as there are about four active breeding months—from May 15th to September 15th—there is time for eight generations or broods. This rapidity of development will account for the flies appearing in such large numbers as to have attracted general attention simultaneously in many widely separated localities. There is no doubt that the pest has been present on our Canadian stock farms throughout the past summer, but has only now increased in sufficient numbers to alarm the owners. Prof. Robertson, the Dairy Commissioner for the Dominion, tells me that he has received an unusual number of complaints this year of flies worrying stock, and these are in all probability attributable to this new importation, whlch brought into the United States only six years ago, has spread in all directions over many States of the Union and is now infesting our herds in Canada.

The appearance of this insect in Canada is a serious matter, for it has been found that stock in infested regions have been so much tormented that animals fall off in condition very much, and the yield of milk is reduced in some instances from one-third to one-half. There are, however, several simple remedies which will, if attended to, greatly reduce this loss, and if all farmers would combine and use them, not only would their animals benefit in comfort but the owners would reap rich returns for their outlay.

Remedies.

Notwithstanding the great loss which may result to stock-owners from neglecting to attend to this new enemy, there is no reason why it should not be kept within control by simple and well tested remedies. This, of course, will be much more easily done if by some united effort steps are taken promptly at its first appearance in a

new locality. From the fact that it has appeared comparatively late in the season, and probably will not this year give trouble much longer, as it always disappears with the first frosts of autumn, farmers will have an opportunity of becoming acquainted with the habits of the pest and of learning the best remedies to be used against it, before a new season opens, and all should be prepared with the return of spring to wage a systematic, vigorous, and persistent warfare, and strive to induce their neighbours to do the same, so as to prevent its increasing in numbers and spreading all over the Dominion.

All accounts agree that the fly increases much more rapidly early in the season than later on in the year. This shows the advantage of being prepared before the pest appears with the necessary materials and beginning work promptly so as to destroy as many as possible before breeding commences.

The remedies are cheap, simple, and easily applied ; but constant attention is required to make them effective. They may be grouped under two heads :

1. Preventive, or such as prevent injury to the animals by keeping the insects from biting them ;

2. Active, the object of which is the destruction of the insects either in the perfect or larval condition.

I. *Preventive.*—Under this heading I cannot do better than quote from the article by Messrs. Riley and Howard in "Insect Life," Vol. II., No. 4, which reads as follows :—

"Almost any greasy substance will keep the flies away for several days. A number of experiments were tried in the field, with the result that train-oil alone and train-oil with a little sulphur or carbolic acid added, will keep the flies away for from five to six days, while with a small proportion of carbolic acid it will have a healing effect upon sores which may have formed. Common axle-grease will answer nearly as well, and this substance has been successfully and extensively used by a large stock-dealer in Virginia. Tallow has also been used to good advantage. The practice of smearing the horns with pine or coal-tar simply repels them from these parts. Train-oil or fish-oil seems to be more lasting in its effects than any other of the substances used."

Crude Carbolic Acid or Oil of Tar, mix sufficiently with fish oils if the two substances be placed together in a bottle and well shaken.

They may be mixed in the proportion of 1 oz. of either in half a gallon of oil. The Oil of Tar has a stronger odour than Carbolic Acid and is cheaper.

The remedy which I think in the long run will be found to be the best is the Kerosene Emulsion, and when farmers have learnt how easily this very valuable remedy against the insect enemies of crops and domestic animals can be prepared, many of the pests which now give trouble will be brought into subjection.

This emulsion consists simply of a mixture of soaps-suds with twice the quantity of ordinary coal oil, made as follows :

Kerosene (coal oil)................	2 quarts,
Rain water........................	1 quart,
Soap..............................	2 oz.

Boil the soap in the water till all is dissolved ; then, while boiling hot, turn it into the kerosene, and churn it constantly and forcibly with a syringe or force pump for five minutes, when it will be of a smooth, creamy nature. If the emulsion be prefect it will adhere to the surface of glass without oiliness. As it cools it thickens into a jelly-like mass. This gives the stock emulsion, which must be diluted before using with nine times its measure, that is 27 quarts, of water. It will be found to mix much more easily if done at once, before it cools.

The above proportions give three quarts of the stock emulsion which with 27 quarts of water added, make up 30 quarts of the mixture ready for use.

This may be applied to the animals either by means of a sponge or what will certainly be found most convenient, where there are many animals to treat, by means of a force pump and spray nozzle.

Prof. W. B. Alwood has found that the stock emulsion diluted ten times and mixed with one part of a water extract of tobacco waste (made by steeping 1 pound of tobacco stems in 1 gallon of hot water for an hour or more), gave almost perfect immunity for a period of three days and that two treatments per week almost entirely relieved his cattle from annoyance. He makes the application with a knapsack pump fitted with a cyclone nozzle, and the work is done just after milking time. His method is as follows .—The animals are driven into an enclosure through a gate which will only admit one at a time. A man with a knapsack pump on his back stands at the gate and sprays one side of each animal as it passes

they are then driven out again, and the other side is treated in the same manner. The quantity of liquid thus applied is very small, but has been found sufficient. Previously, Prof. Alwood employed two men at milking time, and used one or two pints for each animal.

The knapsack sprayer mentioned above consists of a tank of 4 or 5 gallons capacity, fitted with straps for carrying it on the back, and supplied with a small force pump, a few feet of rubber hose and a spraying nozzle. These can be procured from several of the pump makers for about $12, or $14, complete.

Smaller and less expensive pumps would answer equally well, and may be obtained at prices ranging from $2 to $5 from most of our Canadian seedsmen. The following are the addresses of some of the best pump makers in the United States:—

Thos. Woodason, 451 East Cambria St., Philadelphia.

Albinson & Co., 2026 Fourteenth St., Washington, D. C.

Gould's Manufacturing Co., Seneca Falls, N.Y.

The Nixon Nozzle and Machine Co., Dayton, Ohio.

Adam Weaber, Vineland, N. J.

I am not aware that any pumps of the above classes are made in Canada; but doubtless they can be obtained from Canadian agents.

Should there be any Canadian manufacturers who make spraying pumps, I shall be glad to hear from them.

II. *Active.*—Of applications to destroy the fly, a proprietary substance consisting mainly of tobacco dust and creosote, and known as "X. O. Dust," manufactured by a Baltimore firm, is very highly spoken of, particularly by Prof. J. B. Smith, of the New Jersey Experiment Station. This costs about 25 cents a pound. When placed upon the cattle by dusting it through the hair, the flies will not remain long enough on the animals to bite them. Its effects last only about two days.

Kerosene emulsion made as directed above, sprayed over the cattle, killed all the flies reached and prevented others coming, as long as the odour lasted, which was from three to seven days.

Remedies for the destruction of the perfect insects, are mainly useful upon the first appearance of the pest in a new locality, or early in the season for the destruction of the first brood. The best way to fight this enemy is by the treatment of the cattle droppings so as to destroy the eggs and larvæ. The maggots can only live in the dung while it is in a moist condition. Any means, therefore,

which will ensure its drying up before the maggots are full grown, will destroy them. For this purpose lime, land plaster, and wood ashes have been recommended, and the last-named of these will probably be found the best, not only from its strong alkaline properties, which are destructive to insect life, but also from its great value as a fertilizer, and from the further fact that it is easily obtainable on every farm. If farmers could be only induced to keep this valuable material for application to their own land, instead of, as is too often the case, selling it to speculators at much less than its value to themselves, the benefit derived therefrom would much more than repay them for the trouble and expense, even without considering the use for which it is now recommended. Messrs. Riley and Howard state that—"Throwing a spadeful of lime upon a cow dung will destroy the larvæ that are living in it. If the evil should increase, it will well pay a stock-raiser to start a load of lime through his fields occasionally, particularly in May or June, as every larva killed then represents the death of very many flies during July and August. We feel certain that this course will be found in many cases practical and of great avail, and will often be an advantage to the pasture besides."

I am of the opinion that Canadian wood ashes would be far superior to lime for the above purpose, and if neither of these materials were easily obtained, a good shovelful of dry earth or road-dust, would soon absorb the moisture necessary for the development of the larvæ.

What appears to me to be the most practical recommendation, is, that of Prof. J. B. Smith. He says:—"By sending a boy over the pasture every other day with a shovel to thoroughly spread out the cow droppings, all eggs and larvæ would be destroyed." I believe if this were done twice a week it would be sufficient, and would be equally effective in wet weather, when the substance would be washed away, as in hot weather, when it is dried up.

CENTRAL EXPERIMENTAL FARM.

DEPARTMENT OF AGRICULTURE,
OTTAWA, - - - CANADA.

BULLETIN No. 15.

EXPERIMENTS IN THE FATTENING OF SWINE.

OCTOBER, 1892.

To the Honourable

The Minister of Agriculture.

SIR,—I beg to submit herewith for your approval the 15th bulletin of the Central Experimental Farm, which has been prepared under my direction by Jas. W. Robertson, Agriculturist of the Experimental Farm and Dairy Commissioner for the Dominion.

The subject of this bulletin, the economic fattening of swine, is one of particular importance to Canada at the present time. A general consumption by live stock of the coarse grains grown in all parts of the Dominion, would result in retaining to a great extent on the farms, those elements of fertility so essential to the continued growth of good crops. The use of frozen grain for fattening purposes, is also treated of in this bulletin, and the information given on that question is of special value to the farmers of Manitoba and the North-West Territories.

I have the honour to be

Your obedient servant,

WM. SAUNDERS,

Director, Experimental Farms.

OTTAWA, October 29th, 1892.

CENTRAL EXPERIMENTAL FARM.

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DEPARTMENT OF AGRICULTURE.

OTTAWA, - - - - - CANADA.

EXPERIMENTS IN THE FATTENING OF SWINE.

BY JAS. W. ROBERTSON, *Agriculturist.*

Experiments in the feeding of swine were commenced at the Central Experimental Farm in December, 1890. Particulars of the different sorts of feed, of the quantities of feed consumed, and of the increase in the live weight of the animals under the tests, were given in the Annual Report for 1891.

The objects of these first investigations were,—(1) to discover the difference, if any, in the quantity of grain required to produce every pound of increase in the live weight of the swine, *when it was fed steamed and warm*, and *when it was fed raw and cold;* (2) to obtain a record of the comparative quantities of grain required to produce every pound of increase in the live weight of swine during different stages of the fattening period.

The mixture of grain used in the tests was one composed of equal parts of pease, barley and rye, which had been ground. It was saturated with water and fed wet in all cases.

Cold water was given to drink, and a mixture of salt and wood ashes was put in a box on the floor of every pen, where the pigs had access to it at will.

The quantities of feed consumed were weighed every day, and the swine were weighed once every week.

The following Table shows the quantities of feed consumed per pound of increase in live weight, during six feeding periods in four pens :—

TABLE I.

	PEN 1.	PEN 2.	PEN 5.		PEN 6.	
	4 Swine, fed steamed and warm.	4 Swine, fed raw and cold.	4 Swine, fed steamed and warm, plus Sugar Beets.		4 Swine, fed raw and cold, plus Sugar Beets.	
	Lbs. of Grain.	Lbs. of Grain.	Lbs. of Grain.	Lbs. of Sugar Beets.	Lbs of Grain.	Lbs. of Sugar Beets.
Dec. 9 to Jan. 5...........	3·31	3·30	4·69	0·61	3·17	0·84
Jan. 5 to Feb. 2...........	3·07	3·07	2·46	2·00	2·76	2·23
Feb. 2 to Mar. 2	3·79	4·43	3·46	2·00	3·81	2·32
Mar. 2 to Mar 30..........	5·00	7·07	5·40	3·63	3·15	2·13
Mar 30 to Apr. 27.........	7·06	5·68	4·88	4·08	9·51	8·25
Apr. 27 to May 18..........	8·53	5·71	4·17	3·31	6·58	6·00
Average	4·16	4·25	3·86 +	2·46	3·89 +	2·73

Conclusions,—These two sets of experiments indicate that :—

(1.) There is no appreciable difference in the number of pounds of grain required to produce a pound of increase in the live weight of swine, when it is fed steamed and warm, as compared with it when fed raw and cold ;

(2.) On the average there is a gradual and great increase in the quantity of grain consumed for every pound of increase in the live weight of swine, after the second month of the fattening period, and after the average live weight exceeds 100 lbs.;

(3.) It is economical to market swine to be slaughtered when they weigh from 180 to 200 lbs., live weight ;

(4.) The consumption of feed per day is *greatest* at or near the period of their fattening, when the quantity of feed consumed per pound of increase in weight, is *smallest.*

It may be added that to produce an increase of 3,231½ lbs. in the live weight of 24 swine, 4·14 lbs. of a mixture of equal parts of ground pease, barley and rye were required for every pound of increase in the live weight.

EXPERIMENTS IN FEEDING GRAIN, UNGROUND, GROUND AND WITH SKIM-MILK.

During the winter of 1891–2 experiments were begun to discover the effect of feeding swine upon a ration of grain only (unground and ground) as compared with a ration composed of grain and skim-milk. For the purpose, four pens of pigs were selected and sorted into lots as nearly alike as they could be obtained. In each of the four pens were put two pigs out of a Poland-China sow by an Improved Large Yorkshire boar. With them were put three grade pigs in each of the three first pens ; and in the fourth pen two pigs out of a Berkshire sow by an Improved Large Yorkshire boar, were put with the two cross bred Poland-China-by-Yorkshire pigs.

The 9 grade pigs which were put in the first three pens with the 6 crossbred Poland-China-by-Yorkshire pigs, were purchased outside. Their breeding was not known but they appeared to be grades of Chester White or Yorkshire blood. The pigs in the several pens, considered as lots, were as nearly as practicable equal as to breeding, quality, age and size.

The experiment began on January 4th and ended on May 2nd. The feed consumed was weighed every day and the swine were weighed once every week. The following Tables have been arranged to show the average results at four different times in the fattening period.

Table II.

Pen 1 contained 5 swine, as described above—3 grades and 2 cross bred Poland-China-by-Yorkshire. They were fed upon

a mixture of equal parts of pease, barley and rye, *not ground*, and soaked in cold water for 48 hours.

—	Jan. 4.	Feb. 1.	Feb. 29.	Mar. 28.	May 2.	TOTALS.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Live weight	346	386	502	646	780	....
Increase in weight	....	·40	116	144	134	434
Feed Consumed	....	378	490	544	538	1930
Do. per lb. of increase in live weight	....	9·49	4·13	3·77	4·01	4·45

TABLE III.

Pen 2 contained 5 swine similar to those in Pen 1. They were fed upon a mixture of equal parts of pease, barley, and rye, *ground* and soaked in cold water for 12 hours.

—	Jan. 4.	Feb. 1.	Feb. 29.	Mar. 28.	May 2.	TOTALS.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Live weight	346	430	580	741	865	—
Increase in weight	....	84	150	161	124	519
Feed consumed	....	461	572	657	576	2,266
Do. per lb. of increase in live weight	....	5·48	3·81	4·08	4·64	4·26

TABLE IV.

Pen 3 contained 5 swine similar to those in Pens 1 and 2. They were fed upon an allowance of the same mixture as those in Pen 2, (viz. : equal parts of pease, barley and rye, *ground* and soaked in cold water for 12 hours), plus all the skim-milk they would drink.

—		Jan. 4.	Feb. 1.	Feb. 29.	Mar. 28.	May 2.	TOTALS.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Live weight		346	434	590	768	1,017	—
Increase in weight		....	88	156	178	249	671
Feed consumed.	Meal +	....	230	286	432	704	1,652
	Milk	....	1,081	2,078	2,649	3,537	9.345
Do. per lb. of increase in live weight.	Meal +	....	2·61	1·83	2·42	2·82	2·46
	Milk	....	12·28	13·32	14·88	14·20	13·92

Table V.

Pen 4 contained 4 swine, 2 crossbred Poland-China-by-Yorkshire and 2 crossbred Berkshire-by-Yorkshire. They were fed upon an allowance of the same mixture as those in Pens 2 and 3, (viz. : equal parts of pease, barley and rye, *ground* and soaked for 12 hours), plus all the skim-milk they would drink.

—		Jan. 4.	Feb. 1.	Feb. 29.	Mar. 28.	May 2.	Totals.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Live weight		306	395	520	675	842	—
Increase in weight		....	89	125	155	167	536
Feed consumed.	Meal +	....	332	385	514	626	1,857
	Milk	....	610	481	551	938	2,580
Do. per lb. of increase	Meal +	....	3·73	3·07	3·31	3·74	3·46
in live weight.	Milk	....	6·85	3 84	3·54	5·61	4·81

Conclusions,—From these tests which continued seventeen weeks, it appears that :—

(1.) 4·45 lbs. of grain were consumed per lb. of increase in live weight, when it was fed *unground* and soaked for 48 hours ;

(2.) 4·36 lbs. of grain were consumed per lb. of increase in live weight, when it was fed *ground* and soaked for 12 hours ;

(3.) 1 lb. of grain was the equivalent of 6·65 lbs. of skim-milk in increasing the live weight ;

(4.) The swine, which were fed upon a ration containing skim-milk, were lustier and more robust in appearance, than those which were fed upon grain only.

EXPERIMEMTS IN FEEDING FROZEN WHEAT.

The first test in this series was undertaken to discover, (1) what results could be obtained from the fattening of large-sized swine upon a ration of frozen wheat, and (2) how frozen wheat compared with a mixture of equal parts by weight of pease, barley and wheat for increasing the live weight of the animals.

Twelve grade swine were purchased ; their age and breeding were not known. The average weight at the commencement of the test was 186 lbs. each. They were sorted into 3 lots, which were nearly even as to weight, quality and appearance.

The frozen wheat was procured from the branch Experimental Farms at Brandon, Man., and Indian Head, N.W.T. It was graded "No. 2 frozen," "No. 3 frozen," and "unmarketable."

Table VI.

Pen 1 contained 4 swine. They were fed upon frozen wheat *ground* and soaked in cold water for 12 hours.

——	Dec. 28.	Jan. 25.	Feb. 22.	Mar. 14	Totals.
	lbs.	lbs.	lbs.	lbs.	lbs.
Live weight	739	847	969	1100	....
Increase in weight	....	108	122	131	361
Feed consumed	....	701	650	565	1916
Do. per lb. of increase in live weight	....	6·49	5·33	4·28	5·30

Taale VII.

Pen 2 contained 4 swine. They were fed upon frozen wheat, *unground* and soaked for an average of 42 hours. (During the first 2 weeks of the test, the wheat was soaked for only 12 hours ; that may account for the unusually large quantity consumed per lb. of increase in weight).

——	Dec. 28.	Jan. 25.	Feb. 22.	Mar. 14.	Totals.
	lbs.	lbs.	lbs.	lbs.	lbs.
Live weight	745	784	958	1091	....
Increase in weight	....	39	174	133	346
Feed consumed	....	697	945	640	2282
Do. per lb. of increase in live weight	....	17·87	5·42	4·81	6·59

Table VIII.

Pen 3 contained 4 swine. They were fed upon a mixture of equal parts by weight of wheat, barley and pease, *unground* and soaked for an average of 42 hours.

—	Dec. 28.	Jan. 25.	Feb. 22.	Mar. 14.	Totals.
	lbs.	lbs.	lbs.	lbs.	lbs.
Live weight	747	816	963	1114	....
Increase in weight	....	69	147	151	367
Feed consumed	....	673	935	620	2228
Do. per lb. of increase in live weight	....	9 75	6·36	4·10	6·07

Conclusions,—From these tests with heavy swine, it appears that :—

(1.) When the frozen wheat was fed, *ground* and soaked for 12 hours, 11·3 lbs. of increase in the live weight were obtained per bushel of wheat ;

(2.) When the frozen wheat was fed *unground* and soaked for 12 and 42 hours, 9·1 lbs. of increase in the live weight were obtained per bushel of wheat ;

(3.) When the frozen wheat is to be fed *unground*, it should be soaked for at least 42 hours ;

(4.) Leaving out of the reckoning, the weeks during which the frozen wheat *unground*, and the mixture of wheat, barley and pease *unground*, were soaked for only 12 hours, 5·24 lbs. of frozen wheat were consumed per lb. increase, and 5·22 lbs. of the mixture of wheat, barley and pease were consumed per lb. of increase in the live weight.

The second test in this series was made with younger and and smaller swine to discover, (1) the quantity of frozen wheat consumed per lb. of increase in live weight, and (2) the quantity of skim-milk which would be the equivalent of a pound of frozen wheat in increasing the live weight of the swine.

Table IX.

Pen V contained 5 swine bred at the Experimental Farm ; they were out of a Poland-China sow by an Improved Large Yorkshire boar. They were fed upon frozen wheat *ground* and soaked for 12 hours. During the last 3 weeks of the test, they were fed upon the lowest quality of frozen wheat only, which has been graded "unmarketable."

—	Feb. 1.	Feb. 29.	Mar. 28.	Mar. 2.	May 30.	Totals.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Live weight	306	470	595	724	827	....
Increase in weight	....	164	125	129	103	521
Feed consumed	....	565	508	551	580	2,204
do per lb, of increase in live weight	....	3·44	4·06	4·27	5·63	4·23

Table X.

Pen VI contained 4 swine bred at the Experimental Farm ; they were out of a grade Berkshire sow by an Improved Large Yorkshire boar. They were fed upon an allowance of frozen wheat, *ground* and soaked for 12 hours, plus as much skim-milk as they would drink.

—	May 2.	May 31.	June 27.	Totals.
	lbs.	lbs.	lbs.	lbs.
Live weight	415	519	577*	....
Increase in weight	....	104	141	245
Feed consumed { Wheat +	....	327	322	649
Feed consumed { Milk	....	1,601	1,465	3,066
do. per lb. of increase in live weight. { Wheat +	....	3·14	2·28	2·65
do. per lb. of increase in live weight. { Milk	....	15·39	10·39	12·51

* 3 swine only.

Conclusions,—From these tests with swine weighing an average of 61 lbs. each in the one pen and an average of 104 lbs. each in the other pen, it appears that :—

(1.) When the frozen wheat was fed *ground* and soaked for 12 hours, 14·18 lbs. of increase in the live weight were obtained, per bushel of wheat ;

(2.) In the feeding of swine from an average weight of 61 lbs. each, until they reached an average weight of 145 lbs. each, 15·46 lbs. of increase in the live weight were obtained, per bushel of wheat ;

(3.) 1 lb. of frozen wheat was the equivalent of 7·91 lbs. of skim-milk in increasing the live weight ;

(4.) The swine which were fed upon a ration containing skim-milk were lustier and more robust in appearance, than those which were fed upon grain only.

The swine from Pens V and VI were slaughtered ; and the hams, sides and shoulders were cured in pickle by an Ottawa pork-dealer and ham-curer. The bacon and hams were pronounced excellent in quality, by many who examined them and afterwards purchased them for their own tables.

The parts of one side, from a pig of the lot which were fattened upon frozen wheat exclusively, were sent for opinion to Wm. Davies, Esq., of The Wm. Davies Co., Limited, Toronto, who have one of the largest and best known establishments for the curing of swine products in Canada. The following is the sum of the verdict of Mr. Davies upon its quality.

"It is excellent, rather too salt but very rich and luscious. I consider it superior to hogs fed on peas alone. The complaint regarding pea-fed bacon in England, is that the lean is hard and this is the case to some extent with the fat also. It would be well if farmers in Canada would mix the grain and grind it, then give it to the hogs with whey, butter-milk or skim-milk."

GENERAL REMARKS.

In those parts of Canada, where a less or greater quantity of wheat may be injured by frost or other climatic conditions, the farmers should fortify their positions by providing means whereby

to market, in the best way, this product which cannot be sold at paying prices in the form of grain. From 9·1 lbs. to 15·46 lbs. of increase in the live weight of swine have been obtained per bushel of frozen wheat consumed.

When swine are fetching 5 cents per lb. live weight with an allowance of five per cent. deducted for shrinkage, the frozen wheat, fed under the least favourable of ordinary conditions, may realize 43¼ cents per bushel. At the same price for swine, the frozen wheat, fed under favourable conditions in the quality and age of the swine and the preparation of the feed, may realize 73·45 cents per bushel.

The conditions required for the profitable feeding of swine are (1) clean, dry, warm quarters protected from wind and draughts, (2) as much wholesome feed—if grain preferably *ground* fine—as they will eat clean, three times a day, and (3) free access to a mixture of salt and ashes, to sods, or to soil.

To meet the requirements of foreign markets, swine with lean meat are wanted ; larger numbers of them should be fed and fattened during the summer months ; and they should be sold alive by the farmer or feeder in order that they may be slaughtered at packing houses, where the carcasses can be cut and cured in a uniformly satisfactory manner, suited to the preferences of different buyers.

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CENTRAL EXPERIMENTAL FARM.

DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - CANADA.

BULLETIN No. 16.

EXPERIMENTS IN THE FEEDING OF STEERS.

NOVEMBER, 1892.

To the Honourable
The Minister of Agriculture.

Sir,—I have the honour to submit for your approval, the sixteenth bulletin of the Central Experimental Farm, which has been prepared under my direction by Jas. W. Robertson, Agriculturist.

The information contained in this bulletin, has been derived from experiments which have been conducted at the Central Experimental Farm, during the two winters which have passed since cattle were added to its equipment. The economical and profitable feeding of store-cattle and the fattening of steers for market, form a most important branch of the live stock industry of Canada ; and I trust that the conclusions which have been drawn from these experiments, will be accepted by the farmers and be acted upon by them in their practice with great benefit to themselves.

I beg to direct special attention to the results which are reported in the bulletin, from the fattening of steers upon corn ensilage and frozen wheat, and from the feeding of young steers of the Quebec dairy breed of cattle.

I have the honour to be
Your obedient servant,

WM. SAUNDERS,
Director, Experimental Farms.

Ottawa, November 14th, 1892.

CENTRAL EXPERIMENTAL FARM.

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DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - - - CANADA.

BULLETIN No. 16.

EXPERIMENTS IN THE FEEDING OF STEERS.

By Jas. W. Robertson, *Agriculturist.*

Experiments in the fattening of steers were begun at the Central Experimental Farm in December, 1890. The main object of the first experiments, was to obtain information upon the relative cost of fattening steers, (1) upon a ration of which the bulky-fodder portion was mainly corn ensilage, hay and roots, (2) upon a ration of which the bulky-fodder portion was mainly hay and roots, and (3) upon a ration of which the bulky-fodder portion was mainly corn ensilage.

Six 2-year old steers were purchased and were sorted into three lots as nearly even in quality and size as possible. They were apparently all Shorthorn grades. On Dec. 1, the average weight per head was 1,135 lbs. During the test, (which lasted from Dec. 1 to May 18), they were weighed once every week, and the feed which they consumed was weighed every day. They had free access to water in a trough in front of the stalls, and a supply of salt was provided at the side of each manger. The preparatory period of feeding lasted from Dec. 1 to Dec. 29, and during it all the animals were fed upon the same ration.

The three experimental rations were composed as shown in the following Table :—

TABLE I.

RATION NO. 1.	Lbs.	RATION NO. 2.	Lbs.	RATION NO. 3.	Lbs.
Corn Ensilage.......	20			Corn Ensilage......	50
Hay (cut)...........	10	Hay (cut)..........	20		
Roots...............	20	Roots..............	40		
Straw (cut).........	5	Straw (cut).........	5	Straw (cut)...	5
Oil-cake............	1	Oil-cake	1	Oil-cake...........	1
Cotton-seed Meal....	1	Cotton-seed Meal...	1	Cotton-seed Meal...	1
Pease (ground)......	2	Pease (ground)......	2	Pease (ground).....	2
Barley (ground).....	2	Barley (ground).....	2	Barley (ground).....	2
	61		71		61

For a period of five weeks from March 17 to April 20, an additional 1 lb. each of oil-cake and cotton-seed meal were put into each ration.

For the purpose of obtaining some data which would be understood easily and remembered readily by the farmers, and which would afford means for making a comparison between the cost of feeding the steers on the three different rations, a cash value was estimated for the component fodders in each. The hay was valued at \$8 per ton ; roots (turnips and mangels) at \$4 per ton ; straw at \$4 per ton ; oil-cake and cotton-seed meal at \$30 per ton ; pease and barley at \$20 per ton ; and corn ensilage at \$1.40 per ton. The corn ensilage was placed at the actual cost, as per statement in Bulletin No. 12, and the other fodders at an estimated valuation, which may be high or low, according to ever fluctuating circumstances of seasons and markets.

Table II shows, (1) the increase in weight of each steer after 20 weeks, (2) the average quantity of feed consumed per day per head, and (3) the average cost per head per day, for feed consumed.

TABLE II.

RATIONS.		Increase in Weight.	Feed consumed.	Cost per head per day.
		Lbs.	Lbs.	Cents.
No. 1.	Hay, Roots, Corn Ensilage and Meal.	128	52·8	15·58
	do.	182		
No. 2.	Hay, Roots and Meal..............	188	55·5	19 23
	do.	179		
No. 3.	Corn Ensilage and Meal............	221	60.	11·90
	do.	212		

Conclusions. From these tests it appears that :—

(1.) During the feeding period of 20 weeks, the steers which were fed upon Ration No. 3, (corn ensilage and meal), GAINED in weight, on the average, 33 lbs. per head MORE, and COST 7·33 cents per head LESS, per day for feed consumed, than the steers which were fed upon Ration No. 2, (hay, roots and meal) ;

(2.) During the feeding period of 20 weeks, the steers which were fed upon Ration No. 3, (corn ensilage and meal), GAINED in weight, on the average, 61½ lbs. per head MORE, and COST 3·68 cents per head LESS, per day for feed consumed, than the steers which were fed upon Ration No. 1, (hay, roots, corn ensilage and meal) ;

(3.) When the experiment was ended, the steers which were fed upon Ration No. 2, (corn ensilage and meal) were in the most attractive condition of the three lots for handling and selling ;

(4.) A ration of which the bulky-fodder portion was mainly corn ensilage, was more profitable for the fattening of steers, than a ration of which the bulky-fodder portion was mainly or wholly hay and roots.

EXPERIMENTS IN 1891-2.

The experiments in the feeding of steers during the winter of 1891-2, were planned,—

(1.) To obtain further information upon the relative cost of fattening steers upon a ration of which the bulky-fodder portion was mainly, (*a*) in the one case, corn ensilage, hay and roots, (*b*) in another case, hay and roots, and (*c*) in the third case, corn ensilage,—

(2.) To discover the comparative values of feed consumed, per 100 lbs. of increase in live weight, by 3-year-old steers, 2-year-old steers, 1-year-old steers and calf-steers respectively.

THE FATTENING OF TWO-YEAR-OLD STEERS.

Eight 2-year-old steers were purchased and were sorted into four lots as nearly even in quality and size as possible. They were apparently all Shorthorn grades.

The preparatory feeding period lasted from October 29 to December 1, and during it the animals were all fed upon the following ration:—

Corn Ensilage	25 lbs.
Roots	50 "
Straw (cut)	15 "
Pease (ground)	3 "
Barley (ground)	3 "
	96 lbs.

They were each allowed as much of the mixture as they would eat.

On October 29, the average weight per head was 1,079 lbs.; and on December 1, it was 1155 lbs.,—showing a gain of 76 lbs. per head.

Three rations were composed as in Table III.

TABLE III.

Ration No. 1.	Lbs.	Ration No. 2.	Lbs.	Ration No. 3.	Lbs.
Corn Ensilage	20			Corn Ensilage	50
Hay (cut)	10	Hay (cut)	20		
Roots	20	Roots	40		
Straw (cut)	5	Straw (cut)	5	Straw (cut)	5
Oil cake	2	Oil-cake	2	Oil-cake	2
Pease (ground)	2	Pease (ground)	2	Pease (ground)	2
Barley (ground)	2	Barley (ground)	2	Barley (ground)	2
	61		71		61

For the purpose of making a comparison of the relative cost of fattening steers upon the three different rations, a cash value was estimated for the component fodders in each. The hay was valued at $8 per ton ; roots at $4 per ton ; straw at $4 per ton ; oil-cake at $30 per ton ; pease and barley at $20 per ton ; and corn ensilage at $2 per ton. The corn ensilage was valued at a higher figure than in the former experiment (in 1890–1) for the reason that the corn was wilted to a greater extent before it was put into the silos, and because it cost more in 1891 than in 1890 owing to the crop being damaged by a hail storm in August. The prices at which the several fodders are valued for the purposes of this comparison are higher than the cost of production to the ordinary farmer, and may be higher or lower than the prices which could be realised from their sale as fodders.

The following Table shows, (1) the increase in weight of each steer in 18 weeks, (2) the total quantity of feed consumed on the average per head per day, (3) the average quantity of the meal mixture (included in the former) consumed per head per day, and (4) the average cost per head per day, for feed consumed.

TABLE IV.

RATIONS.		Increase in Weight.	Feed consumed per head.	Meal in feed per day.	Cost per head per day.
		Lbs.	Lbs.	Lbs.	Cents.
No. 1.	Hay, Roots, Corn Ensilage and Meal	152	61·96	6·09	18·28
	do. do.	265			
No. 2.	Hay, Roots and Meal............	165	53·92	4·55	18·22
	do.	213			
No. 3.	Corn Ensilage and Meal..........	260	67·92	6·68	14·47
	do.	229			

THE FATTENING OF STEERS ON CORN ENSILAGE AND FROZEN WHEAT.

From December 1 until January 5, the other two steers were fed upon a ration composed of,—

Corn Ensilage.....................	50 lbs.
Straw (cut).......................	5 "
	55 lbs.

During that period, they gained in weight an average of 11 lbs. per head, and consumed on the average 61·9 lbs. of feed per head per day, at a cost of 6·75 cents per head per day.

From January 5 until April 5, these two steers were fed upon a ration composed of,—

Corn Ensilage....................	50 lbs.
Straw (cut).........	5 "
Frozen Wheat (ground)...........	6 "
	61 lbs.

During that period of 13 weeks, they gained in weight an average of 159 lbs. per head, and consumed on the average 59·88 lbs. of feed per head per day, at a cost of 9·32 cents per head per day. The frozen wheat was valued at 35 cents per bushel.

Table V shows, (1) the average increase in weight per head per day, (2) the average cost per head per day for feed consumed, and (3) the average cost of feed consumed per 100 lbs. of increase in live weight.

TABLE V.

RATIONS.	Increase in weight per day.	Cost per head per day.	Cost per 100 lbs. increase in weight.
	Lbs.	Cents.	$
No. 1. Hay, Roots, Corn Ensilage and Meal.	1·65	18·28	11·05
No. 2. Hay, Roots and Meal..................	1·50	18·22	12·14
No. 3. Corn Ensilage and Meal.............	1·94	14·47	7·45
No. 4. Corn Ensilage and Frozen Wheat ...	1.74	9·32	5·33

Conclusions. From these tests it appears that :—

(1.) During the feeding period of 18 weeks, the steers which were fed upon Ration No. 3 (corn ensilage and meal), GAINED in weight on the average 55½ lbs. per head MORE, and COST 3·75 cents per head LESS, per day for feed consumed, than the steers which were fed upon Ration No. 2 (hay, roots and meal) ;

(2.) During the feeding period of 18 weeks, the steers which were fed upon Ration No. 3 (corn ensilage and meal), GAINED in

weight on the average 36 lbs. per head MORE, and COST 3·81 cents per head LESS, per day for feed consumed, than the steers which were fed upon Ration No. 1 (hay, roots, corn ensilage and meal) ;

(3.) The *cost* for feed consumed per 100 lbs. of increase in live weight, was *62·95 per cent. greater* on Ration No. 2 (hay, roots and meal), and *48·32 per cent. greater* on Ration No. 1 (hay, roots, corn ensilage and meal) than it was on Ration No. 3 (corn ensilage and meal) ;

(4.) On Ration No. 2 (hay, roots and meal) the quantity of meal consumed per head per day, was 4·55 lbs. as against 6·68 lbs. per head per day on Ration No. 3 (corn ensilage and meal) ;

(5.) The quality of the beef, from the steers fed upon corn ensilage and frozen wheat, was pronounced to be particularly excellent by the butchers, and by the members of 8 different households who examined it critically when served as roast beef.

THE FEEDING OF THREE-YEAR-OLD STEERS.

Four 3-year-old steers were purchased and were sorted into two lots of apparently even quality. On December 3, the operation of dehorning was performed on them. The wounds on the heads of three of the animals appeared to be acutely painful for about a week, and during that time they all lost from 40 to 100 lbs. each. The other animal did not seem to suffer much, after the operation of sawing off the horns was ended. After the wounds were healed the animals were fed loose in a cold shed with only one thickness of lumber between them and the outside air.

The preparatory feeding period lasted from October 29 to December 1, and during it the animals were all fed upon the following ration :—

Corn Ensilage....................	25 lbs.
Roots..............................	50 "
Straw (cut).......................	15 "
Pease (ground)..................	3 "
Barley (ground).................	3 "
	96 lbs.

NOTE.—To furnish further data for a comparison between the bulky-fodder portions of Ration Nos. 1, 2 and 3, an equal quantity of meal per head per day, will be fed to the several animals in our next series of experiments, instead of equal quantities of meal being added to the different rations.

They were each allowed as much of the mixture as they would eat.

On October 29, the average weight per head was 1,182 lbs.; and on December 1, it was 1,251 lbs.,—showing a gain of 69 lbs. per head.

Two rations were composed as in Table VI.

TABLE VI.

RATION No. 3.	Lbs.	RATION No. 5.	Lbs.
Corn Ensilage	50	Corn Ensilage	50
Straw (cut)	5	Straw (cut)	5
Oil-cake	2		
Pease (ground)	2		
Barley (ground)	2		
	61		55

For the purpose of making a comparison, a cash value was estimated for each of the component fodders in each ration as mentioned after Table III.

The following Table shows, (1) the increase in weight of each steer in 18 weeks, (2) the quantity of feed consumed on the average per head per day, (3) the quantity of the meal mixture (included in the former) consumed per head per day, and (4) the average cost per head per day, for feed consumed.

TABLE VII.

RATIONS.		Increase in Weight.	Feed Consumed.	Meal in feed per day.	Cost per head per day.
		Lbs.	Lbs.	Lbs.	Cents.
No. 3.	Corn Ensilage and Meal	102	65·96	6·48	14·05
	do. do.	155			
No. 5.	Corn Ensilage	50	54·65	0	5·96
	do.	7			

THE FEEDING OF ONE-YEAR-OLD STEERS.

Four 1-year-old steers were purchased and were sorted into two lots of apparently even quality.

The preparatory feeding period lasted from October 29, to December 1, and during it, the animals were all fed upon the following ration :—

Corn Ensilage	25 lbs.
Roots	50 "
Straw (cut)	15 "
Pease (ground)	3 "
Barley (ground)	3 "
	96 lbs.

They were each allowed as much of the mixture as they would eat.

On October 29, the average weight per head was 751 lbs.; and on December 1, it was 805 lbs.;—showing a gain of 54 lbs. per head.

From Dec. 1 until April 5, both lots were fed upon Ration No. 3:—

Corn ensilage	50 lbs.
Straw (cut)	5 "
Oil-cake	2 "
Pease (ground)	2 "
Barley (ground)	2 "
	61 "

The two steers of one lot, were fed loose in a cold shed with only one thickness of lumber between them and the outside air ; and the two steers of the other lot, were fed tied in stalls in the cattle stable. The average temperature of the stable would be about 50° Fahr.

The following Table shows, (1) the increase in weight of each steer in 18 weeks, (2) the quantity of feed consumed on the average, per head per day, (3) the quantity of the meal mixture (included in the former), consumed per head per day, and (4) the average cost per head per day, for feed consumed.

TABLE VIII.

RATIONS.	How fed.	Increase in weight.	Feed consumed per head.	Meal in feed per day.	Cost per head per day.
		Lbs.	Lbs.	Lbs.	Cents.
Corn Ensilage and Meal......	In stable..	173	45·25	4·45	9·64
do.	do. ..	163			
do.	In shed...	172	43·94	4·32	9·36
do.	do. ...	129			

Conclusion. From this single test, it is not evident that there was an appreciable difference in the increase in the weight of the steers, or in the quantity of feed consumed, which was due to the place or manner of feeding,—stable *v.* shed and tied *v.* loose.

THE FEEDING OF CALF-STEERS.

Four calf-steers were put under test on Rations Nos. 2 and 3. Each lot contained one steer, out of a grade Shorthorn cow by a Shorthorn bull, and one steer out of a "Quebec Jersey" or "French Canadian" cow. The breeding of the sire of the Quebec steers was not known to us.

The preparatory feeding period lasted from Oct. 29 to Dec. 1, and during it the animals were all fed upon the following ration :—

Corn Ensilage....................	25 lbs.
Roots..............................	50 "
Straw (cut)......................	15 "
Pease (ground)...................	3 "
Barley (ground)..................	3 "
	96 "

They were each allowed as much of the mixture as they would eat.

On Oct. 29, the average weight per head was 465 lbs. ; and on Dec. 1, it was 526 lbs.,—showing a gain of 61 lbs. per head.

The two rations were composed as in Table IX.

TABLE IX.

Ration No. 2.	Lbs.	Ration No. 3.	Lbs.
		Corn Ensilage..........	50
Hay (cut)....................	26		
Roots....	40		
Straw (cut)....................	5	Straw (cut)..................	5
Oil-cake......................	2	Oil-cake.....................	2
Pease (ground)................	2	Pease (ground)...............	2
Barley (ground)..............	2	Barley (ground).............	2
	71		61

For the purpose of making a comparison, a cash value was estimated for each of the component fodders in each ration, as mentioned after Table III.

The following Table shows, (1) the increase in weight of each steer in 18 weeks, (2) the quantity of feed consumed on the average per head per day, (3) the quantity of the meal mixture (included in the former) consumed per head per day, and (4) the average cost per head per day, for feed consumed.

TABLE X.

RATIONS.		Breed.	Increase in weight.	Feed consumed per head.	Meal in feed per day.	Cost per head per day.
			Lbs.	Lbs.	Lbs.	Cents.
No. 2.	Hay, Roots and Meal.	Shorthorn.	255	30·71	2·59	10·38
	do.	Quebec....	164			
No. 3.	Corn Ensilage & Meal.	Shorthorn.	212	35·25	3·46	7·51
	do.	Quebec....	175			

The following Tables have been arranged to show, (1) the relative rates of increase in weight, (2) the relative cost per head per day, and (3) the relative cost of feed consumed per 100 lbs. of increase in live weight, of the steers of Shorthorn and Quebec blood respectively.

Table XI.

	Breed.	Weight Dec. 1.	Weight April 5.	Increase.
		Lbs.	Lbs.	Lbs.
Steer No. 174..............	Shorthorn.....	595	850	255
do. 173..............	Quebec..	480	644	164
do. 172......	Shorthorn.....	600	812	212
do. 171......	Quebec........	430	605	175

Table XII.

Rations.		Breed.	Increase in weight per day.	Feed consumed per day.	Cost per head per day.	Cost per 100 lbs. of increase in weight.
			Lbs.	Lbs.	Cents.	$
No. 2.	Hay, Roots and Meal.	Shorthorn.	2·02	35·85	12·11	5·99
	do.	Quebec....	1·30	25·65	8·67	6·66
No. 3.	Corn Ensilage & Meal.	Shorthorn.	1·68	30·00	8·31	4·94
	do.	Quebec....	1·38	31·50	6·71	4·83

Conclusions. From these tests with calf steers, it appears that :—

(1.) During the feeding period of 18 weeks, the steers which were fed upon Ration No. 3 (corn ensilage and meal), GAINED in weight on the average 16 lbs. per head LESS, and COST 2·87 cents per head LESS, per day for feed consumed, than the steers which were fed upon Ration No. 2 (hay, roots and meal) ;

(2.) The *cost* for feed consumed per 100 lbs. of increase in live weight, was *27·6 per cent. greater*, on Ration No. 2 (hay, roots and meal), than it was on Ration No. 3 (corn ensilage and meal) ;

(3.) The *cost* of feed consumed per 100 lbs. of increase in weight was *lowest* in the case of a calf steer of "French Canadian" or "Quebec Jersey" breed, fed upon Ration No. 3 (corn ensilage and meal).

COMPARISONS IN THE FEEDING OF STEERS OF DIFFERENT AGES.

In the foregoing Tables some information has been given showing the comparative quantities of feed consumed and the cost per 100 lbs. of increase in live weight, by 3-year-old steers, 2-year-old steers, 1-year-old steers and calf steers respectively, when fed upon the same ration.

The following additional Tables have been arranged to present a comparison of the results in convenient form. The lots which are compared were fed from Dec. 1 to April 5, upon Ration No. 3, viz.:—

Corn Ensilage	50 lbs.
Straw (cut)	5 "
Oil-cake	2 "
Pease (ground)	2 "
Barley (ground)	2 "
	61 lbs.

Table XIII.

STEERS.	Increase in Weight.	Increase in weight per day per head.	Feed consumed per day per head.	Meal in feed per day per head.	Cost per head per day.	Cost per 100 lbs. of increase in weight.
	Lbs.	Lbs.	Lbs.	Lbs.	Cents.	Dollars.
3-year-old, No. 189.	102	1·02	65·96	6·48	14·05	13·77
do. No. 188.	155					
2-year-old, No. 183.	260	1·94	67·92	6·68	14·47	7·45
do. No. 182.	229					
1-year-old, No. 178.	173	1·33	45·25	4·45	9·64	7·23
do. No. 177.	163					
Calf steer. No. 172.	212	1·53	35·25	3·46	7·51	4·89
do. No. 171.	175					

Conclusions. From this one series of experiments, it appears that :—

(1.) The *cost* for feed consumed per 100 lbs. of increase in live weight was *lowest* in the case of calf-steers, viz.: $4·89 per 100 lbs.;

(2.) The *cost* for feed consumed per 100 lbs. of increase in live weight was *84·83 per cent. greater*, by the 3-year-old steers than by the 2-year-old steers ;

(3.) The original weight of the 2-year-old steers, was enhanced *in value per lb.*, quite as much by the feeding for 18 weeks, as was the original weight of the 3-year-old steers ;

(4.) The original weight of the 1-year-old steers and calf-steers, was not enhanced *in value per lb.*, to any appreciable extent by the feeding for 18 weeks.

NOTES.—The 1-year-old steers and calf steers have been carried over to be fed during the winter of 1892-93.

The corn ensilage, which was used in these experiments, was made from several varieties of Indian Corn, most of which had not reached the early milk stage of growth. By the planting of varieties of corn which ripen early (mainly Longfellow and Pearce's Prolific) a quality of ensilage which appears to be much superior, has been provided for the feeding experiments of 1892-93.

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CENTRAL EXPERIMENTAL FARM.

DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - CANADA.

BULLETIN No. 17.

CHERRIES.

NOVEMBER, 1892.

To the Honourable

The Minister of Agriculture.

SIR,—I beg to submit herewith for your approval, the seventeenth Bulletin from the Central Experimental, Farm which has been prepared under my direction by Mr. John Craig, Horticulturist of the Experimental Farm. The subject of this Bulletin is Cherries, and in it there is given much information regarding the hardier and more promising sorts which have been tested in the cherry orchard at the Central Experimental Farm, and especially in reference to those varieties which have been brought to America within the past few years from Northern Europe.

From the information here submitted, it would appear that there are among the newer cherries tested, varieties of special merit as to hardiness, vigour of growth and quality of fruit, which should now be disseminated and tried in a more general way. With the view of assisting to bring about this desirable end, buds of these cherries have been freely distributed during the past season among Canadian nurserymen and fruit growers, and a similar distribution will be made on application during the propagating season of 1893. It is hoped that through this action young trees of those sorts most desirable, may soon be available to the public through the usual channels of trade, and that thus a desirable impetus may be given to cherry growing throughout the Dominion, and especially in those districts. where the winters are unfavourable for the growth of the more tender sorts.

The illustrations used in this Bulletin have been engraved especially for this publication from photographs of the fruit taken under the personal supervision of Mr. Craig.

I have the honour to be

Your obedient servant,

WM. SAUNDERS,

Director.

Central Experimental Farm.

—:o:—

DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - - - CANADA.

CHERRIES.

By John Craig, *Horticulturist.*

The aim of this bulletin is to draw attention to a class of cherries, containing a number of varieties which appear to possess much value for those sections of the Dominion, where by reason of the severity of the climate, sweet cherries cannot be grown profitably. The varieties mentioned hereafter are in the main personal selections, made by Prof. J. L. Budd of the State Agricultural College, Ames, Iowa, and the late Charles Gibb of Abbotsford, Quebec, when inspecting the fruits of East Europe in 1882. Importations followed in 1883. The writer was afford d an opportunity of studying the merits of the individuals of this class of cherries at Ames, between 1886 and 1889. The cherry orchard at the Central Experimental Farm where the varieties described have, for the past three years, been under my observation, was planted by Mr. W. W. Hilborn in 1888. Some of the trees were purchased from Stone & Wellington of Welland, and D. W. Beadle of St. Catherines, Ont.; J. M. Fisk of Abbotsford, Que., and Ellwanger & Barry of Rochester, N.Y.; but the larger number were obtained from Prof. Budd of Iowa and the late Mr. Chas. Gibb of Abbotsford, Que. During the spring of 1887, it was my privilege under direction of Prof. Budd to select the varieties which were sent from Iowa to the Experimental Farm. The Iowa trees were all propagated by root grafting, using Mahaleb or Mazzard stocks,—principally the

latter. The soil of the cherry orchard at Ottawa is a light, well drained sandy loam, having a stiff sub-soil, composed of gravel and clay. The trees were planted 20 feet apart each way. The inter-spaces have been cropped every year, except a space of from four to six feet which was left on each side of every row of trees. These strips have been cultivated annually up to mid-summer with a one horse cultivator; an occasional light hoeing afterwards has prevented weeds from going to seed. The manuring has consisted of one application of barnyard manure in 1888, and a dressing of unleached wood ashes, at the rate of 125 bushels to the acre, in the spring of 1890. This treatment has been productive of a healthy, vigorous growth, and seems to have promoted early fruitage. The first specimens of fruit were picked in 1890. The increase in quantity and variety has been rapid, forty varieties having fruited the past season, many of them yielding full crops. Thus far the trees have been entirely free from black knot. It is not intended at this time to make a scientific classification of the varieties herein described.

Considered from a commercial aspect, cultivated cherries belong to one of two groups, which are outlined more or less roughly. Group I. includes Heart and Bigarreau cherries; rapid growing varieties attaining large size, having much larger leaves than the next group, and bearing fruit, sweet and tender, as well as firm fleshed. The varieties of this class as a rule are not reliable where the climate is so severe as to prohibit peach culture.

Group II. includes Duke and Morello cherries. Formerly the distinctive lines dividing the Duke from the Morello varieties were drawn with considerable accuracy, but the rapid multiplication of varieties from seed, the probable product of natural crosses, has complicated classification so much, that of late years these two families have been generally grouped under one heading. The Dukes as a class are upright growers, with rather stout branches and leaves of moderate size, while the typical Morellos are round topped, with smaller leaves and slender branches more or less drooping. Intermediate forms are numerous, and it is a matter of some difficulty at the present time to assign to each new variety its true position.

A very interesting account of Russian and German cherries, illustrating methods of propagation and cultivation, was published

by the late Mr. Gibb in the Eighth Report of the Montreal Horticultural Society. Writing of the Vladimir, as grown in Central Russia, he states that it grows in "bush form, and when it becomes too old to bear profitably, the older parts are cut away and new sprouts take their place. It is usually grown in sod, and under such lack of culture brings good returns, hence its great value to us as a tree for careless cultivators. It may be grown from seed, as it often is, but as it varies somewhat, it is better to propagate from the best sorts by sprouts. Sometimes, though rarely, it is grafted. Some trees are erect in growth, others weeping. Both forms are widely scattered. Some have red flesh, but as a rule the flesh is deep purplish red; the skin, when fully ripe, is reddish black, and later, when almost over-ripe, a rich mingling of acid and sweetness; when quite over-ripe it loses its acidity and combines with its sweetness somewhat of the peculiar bitter of the commoner kinds of Guigne." This is quoted to draw attention to, and keep in mind, the manner of propagation of these varieties in their native home. What ultimate effect propagation in this climate by root grafting and budding will have on them cannot at present be conjectured. As a first effect the size of the tree seems considerably increased beyond normal dimensions. While relatively many may correctly be classed as dwarfs, yet it can be said that grafted varieties in this climate, after five years' growth, have attained a greater size than Mr. Gibbs' description would lead us to believe was reached in Russia by the oldest seedling trees.

It is unsafe on the strength of the results of a trial of a few years, to unqualifiedly recommend any of our tree fruits, the actual value of which can only be correctly determined by the experience of many years. The opinions here advanced should be considered tentative until confirmed or modified by later experience. Further investigation may reduce the number of varieties by showing that some here noted are not sufficiently distinct to warrant a separation from others which they closely resemble. At this time it is thought best to note such doubtful individuals separately.

The illustrations made use of are from photographs, taken natural size, of fruit grown either at the Central Experimental Farm, Ottawa, or at Abbotsford, Quebec.

AMARELLE HÂTIVE. (*Early Amarelle.*)

Received from Prof. Budd in 1887. It has made fair growth and thus far has not been injured by the cold of winter. It began fruiting in 1890, bearing the present year a full crop. Fruit large, obtusely heart shaped, with suture fairly well defined. (See Fig. 1). Skin dark red, stalk long, slender, set in a deep cavity. Flesh well tinged with red, quite rich and juicy. Pit, medium to large. Quality

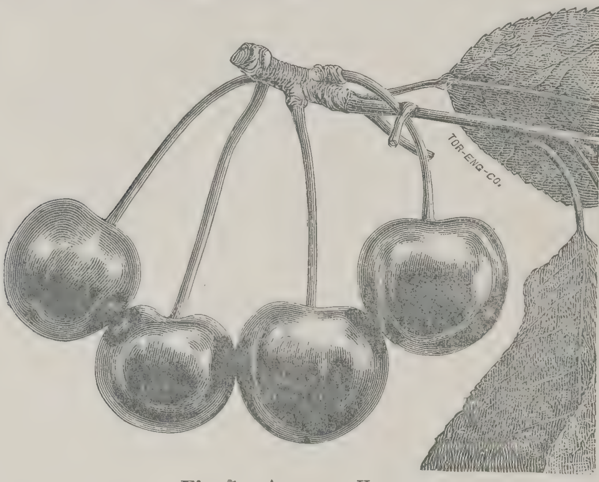

Fig. 1.—AMARELLE HATIVE.

good. Ripe this year July 10th. This variety would appear to be valuable on account of earliness and productiveness. The name would indicate French origin, but it does not appear in "Guide Pratique" of Frères Simon-Louis of Metz, Germany.

BESSARABIAN (*No. 62 of Prof. Budd*). This variety is said to belong to a race believed to have been introduced from Central Asia. Fruit medium to large, generally produced in pairs, bright red, considerably flattened sidewise and at the apex. Stalk long slender, set in a deep cavity. Flesh firm, dark red, sharply, sub-acid, without astringency when fully ripe. Pit small and round. Ripens here the first week in August. Tree a free grower, somewhat spreading, leaf medium to small, oval coarsely toothed. Strictly hardy. Crown grafted on Mahaleb, this variety makes a rapid growth and seems to find the stock congenial.

BRUSSELER BRAUN. (*Brune de Brusselles, Ratafia of Hogg*). As fruited here this corresponds to the description by Mr. Gibb,

who saw it in bearing in Germany. Fruit large heart-shaped inclined to spherical. Skin dark red, almost black. Stalk about 2 inches in length, set in a moderately deep cavity. Flesh firm, highly colored, quite acid, closely resembling Schatten Amarelle. Ripe this year August 10th. Mr. Gibb says on account of its large size and good colour it sells in the Warsaw market at one-fourth more than Ostheim. Tree a free open grower, fairly hardy.

Carnation.—This is noted by Dr. Hogg as one of the oldest varieties of the red Duke family in cultivation, it has succeeded admirably on these grounds, the tree being hardy and very productive. Fruit medium to small, round. Flesh firm, without much juice Ripens towards the end of July. It should receive a trial on light soil where Richmond fails.

Cerise d'Ostheim.—As fruited here this is not equal to Minnesota Ostheim, although Prof. Budd speaks highly of it at Ames. Fruit of medium size lacking the firmness of the Ostheim, and ripening a few days later, somewhat astringent.

Double-Glass (*Doppelte Glas*).—A very distinct type of tree of upright habit, with thick twigs and large prominent buds. Fruit of the largest size, heart shaped with a deep suture. Stalk thick 1 to 1½ inches long. Flesh yellow and firm, juice uncolored. Ripens towards the end of July. The above notes were made on fruit grown at Abbotsford, Que., where the tree was planted eight years ago. At Abbotsford it is not strictly hardy. Worthy of trial in Southern Ontario.

Fouchès' Morello.—Fruit medium to large, obtusely heart shaped, stalk long, slender; skin bright red, semi-transparent. Flesh moderately firm, very juicy, good quality. Pit small round. Ripe this year July 15th, four or five days after Amarelle Hâtive. Tree a small compact grower, hardy. Worthy of trial in all cherry growing districts.

Frauendorfer Weichsel.—This is recommended by Prof. Budd as a tree both hardy and productive. As fruited here it has been of small size and only medium in quality, ripening the last week in July. It may be valuable in the colder districts.

Griotte du Nord (*Northern Griotte*).—Introduced by Prof. Budd from Silesia. Fruit usually borne in pairs, medium to large spherical, skin dark red; stalk long slender. Flesh highly colored, juicy, rather acid but pleasant; pit of medium size. This description

coincides with that given by Freres Simon Louis, in "Guide Pratique." Tree a slow grower of compact habit. Hardy.

GRIOTTE d'OSTHEIM appears to be so closely allied to Ostheim as to render a description unnecessary. At Abbotsford it matures four or five days earlier, and is perhaps a little finer in quality.

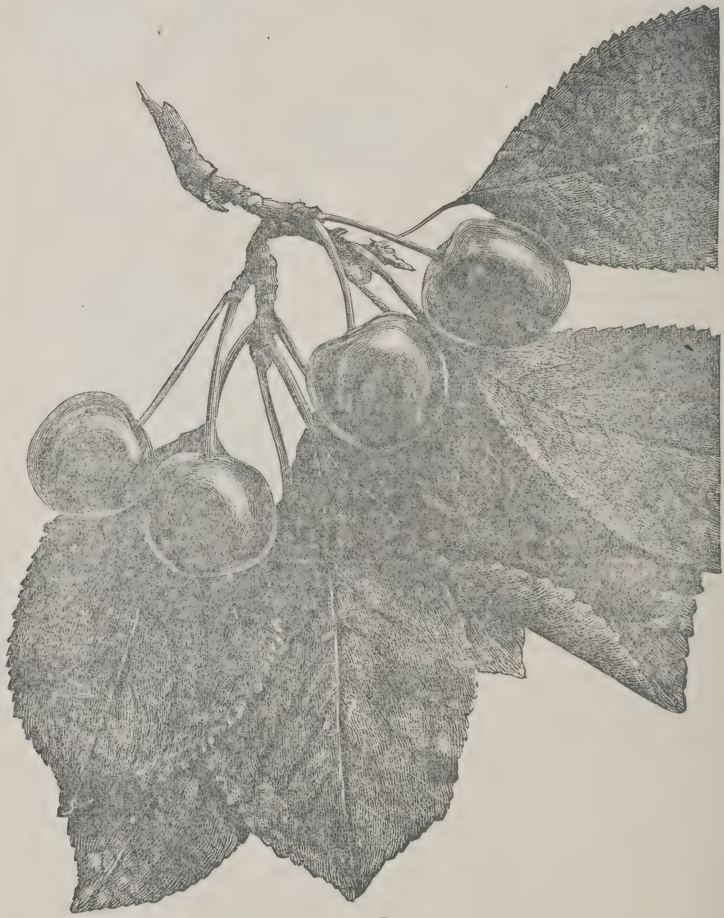

Fig. 2.—GRIOTTE IMPERIALE.

GROS GOBET (*Montmorency à courte queue*).—Not hardy at Ottawa, but should be valuable as a canning cherry in Southern Ontario. Fruit large, borne in clusters; oblate with a deep suture extending from apex to stem cavity. Skin bright red, stalk stout $\frac{3}{4}$ to 1 inch in length with pit firmly attached. Flesh white, tender. For culinary purposes. Ripe the last week in July.

Griotte Imperiale.

Imported from Metz, Germany, by Mr. Chas. Gibb. At Abbotsford this has been a slow grower, hardy and productive ; fruit medium to large, oval in form ; skin, dark red. (See Fig. 2.) Flesh firm and like the juice deeply colored Quite acid with a rich mingling of sweet and sour, ripens about the middle of July. This would seem promising for the Province of Quebec and for Central Ontario.

Lithauer Weichsel.—This has been distributed to some extent by Canadian nurseymen, notably Stone and Wellington, We land, Ont., but while a good tree the fruit is inferior in size and quality to many others. Fruit small, round, almost black. Flesh firm, acid. Tree a free grower, fairly hardy. Prof. Budd says, "much grown south-west Russia for drying and cherry wines." Where Vladimir succeeds, this need not be planted.

Lieb.—A Morello variety of Richmond type, ripening a week later in this locality, promising.

Montmorency (*Large Montmorency*)—Fuit medium size, roundish oblate, with marked suture, skin light red, thin and tough, stalk 1 to $1\frac{1}{2}$ inches in length, set in a deep round cavity. Flesh white, tender, juicy, lacking richness ; matures the last week of July. This variety is thought by Dr. Hogg to be a synonym of *Montmorency à courte-queue*. As grown here it is, however, distinct. In some sections it is superseding Early Richmond. Tree fairly hardy and productive.

Minnesota Ostheim.

Speaking of the *Ostheim*, Mr. Gibb said, "I am told by Director Stoll of Proskau, that this is a native of the Sierra-Nevada Mountains, in Spain, where it was found at elevations of 5,000 and 6,000 feet, and that it was brought to Germany in 1687 by a German Professor, who grew it in the neighbourhood of the town of Ostheim, whence its present name." That a number of varieties are represented by the family name Ostheim there is little doubt. Neither at Abbotsford, nor on these grounds have Griotte d'Ostheim, Cerise d'Ostheim, nor the Ostheim, now found in trade catalogues, equalled in quality or productiveness the variety above mentioned. It seems to have been introduced from Germany by Mr. E. Myer, who settled at St. Peter, Minnesota, and brought with him sprouts of this cherry. (Iowa Hort. Soc.

Report, 1881, p. 371.) Fruit much larger than Richmond, obtusely heart shaped ; sature obscurely marked ; skin dark red ; when fully ripe a brownish black ; (see fig. 3) stalk two or more inches in length ; flesh tender ; deeply colored ; quality good ; pit medium to large ; productive ; maturing from July 15th to 25th. Tree of the round topped, half dwarf Morello type. This is recommended with a considerable amount of confidence in its future success.

Fig. 3.—MINNESOTA SOUTHERIN.

No. 18, RIGA. This was introduced by Prof. Budd, from Riga, Russia. Fruit large, heart shaped, dark red ; stalk long, slender ; flesh firm, juice colored, pit small ; quality good ; ripening about July 12th ; an attractive variety combining many good points. Tree resembles Ostheim but is a slower grower.

OREL, No. 25.

Prof. Budd obtained from Orel, Russia, several varieties under number; these have been sent out in the same way. Varieties on trial include Nos. 23, 24, 25, 26 and 27. The following description applies to Orel No. 25, (see fig. 4) which appears to be the most valuable. Fruit borne singly or in clusters, large, heart-shaped; skin light red ; juice uncolored ; stalk an inch to an inch and a half long ; flesh tender, very juicy, sub-acid ; pit medium to small ; ripe this

year the first week in August, but fruit allowed to remain on the tree was in good condition August 15th. Tree is a vigorous upright grower, hardy ; an important addition to our late cherries.

OSTHEIM.—See *Minnesota Ostheim.*

OLIVET. This appears to have been introduced by American nurserymen from France. Evidently belonging to the Duke tribe. It is not yet well known. Fruit large, oblate, borne in large clusters ; bright red ; flesh firm ; juice uncolored ; quality medium to good. A very attractive variety apparently as hardy as Early Richmond.

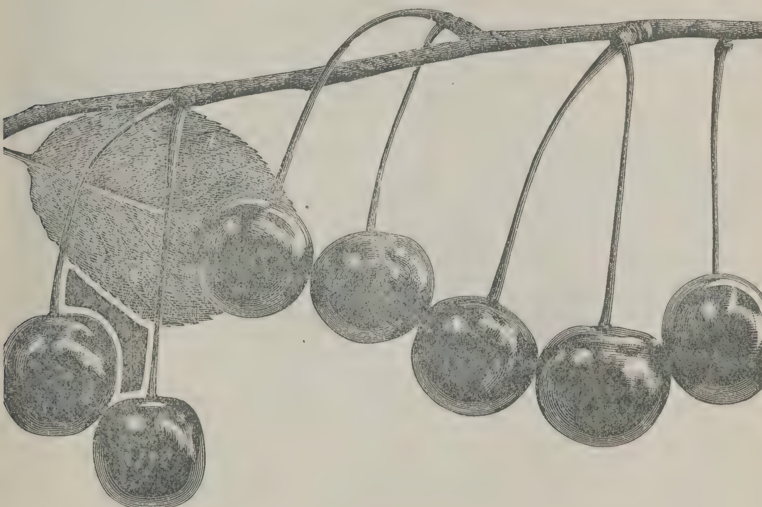

Fig. 4.—OREL No. 25-

STRAUSS WEICHSEL.—The name of this variety should be abbreviated to *Strauss.* Trees on the Experimental Farm were obtained from Mr. Gibb in 1889. Fruit medium to large, a rich dark red, roundish, flattened at both ends; stalk short set in a shallow cavity ; flesh dark red, firm, juicy and sprightly with slight astringency ; pit small ; very good. Tree a small upright grower with leaves medium to small, moderately hardy.

Späte Amarelle.

Although the name indicates late, yet it is one of the earliest varieties in the collection, ripening this year with *Amarelle Hâtive*, which it resembles so closely as to render description unnecessary. The tree is a model in point of vigour and hardiness. (See Fig. 5).

Fig. 5.—Spate Amabelle.

Schatten Amarelle. (*Shadow Amarelle.*)

Prof. Budd remarks that it is much like the last. The resemblance is certainly very close, but Schatten Amarelle (see fig. 6) is fully two weeks later in ripening its fruit; the juice too is colorless. Ripe this year August 5th. Tree a vigorous grower, maintaining a round topped habit. This is one of the most promising late cherries on trial.

Vladimir.—(See Fig. 7).

This variety attracted the attention of Mr. Gibb when in Russia more than any other. He said: "First in importance are

the cherries known all over Russia under this name. It has been named Vladimir, I suppose, because in that Government its culture has attained such vast proportions." This variety was distributed to the members of the Ontario Fruit Growers Association some years ago. That the tree is perfectly hardy has been conclusively demonstrated. In many sections, however, especially on clay soil, while the trees have blossomed freely, as a rule the fruit has not set well. Budded on Mahaleb and grown as a standard, with a stem four feet high, as propagated by Messrs. Stone & Wellington,

Fig. 6.—Schatten Amarelle.

Welland, Ont., it has been very fruitful on these grounds. Fruit medium to small, borne in clusters containing from two to four

fruits. Skin nearly black. Flesh firm, with a sprightly acidity. Stalk of medium length; pit round and rather large. Leaves obovate sometimes acuminate; irregulary toothed. Fig. 7 shows fruit a little above natural size.

Canadian grown seedlings from the Vladimir are now growing in Ottawa and may show a more perfect adaptation to our climatic conditions than the original stock.

Fig. 7.—VLADIMIR.

WEIR'S CHERRIES.—A number of seedlings produced by Mr. D. B. Weir, at Lacon, Illinois, have been on trial the past four years, but insufficient data prevents notes or descriptions being given at the present time.

Wragg.

Mr. John Wragg of Waukee, Iowa, informs me that this appeared as a sprout among a lot of Morello cherries purchased from Messrs. Ellwanger & Barry, Rochester, N.Y., twenty or more years ago. Its hardiness and productiveness attracted his attention. It has now become widely disseminated, and is doing well in many sections. Two of the three trees planted here have been injured by winter. In appearance and season the fruit resembles English Morello quite closely, ripening this year the first week in August. (See Fig. 8).

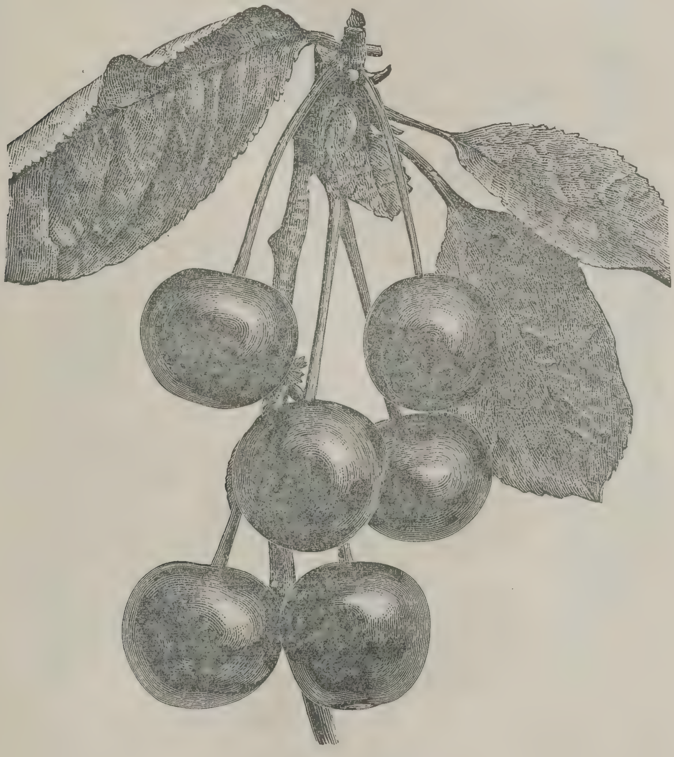

Fig. 8.—Wragg.

Varieties Recommended.

With present experience the following varieties are recommended for trial, and will probably prove valuable in those sections where

climatic conditions permit the cultivation of the pear: *Amarelle Hâtive*, *Strauss*, *Griotte Impériale*, *Olivet*, *Gros Gobet.*

The following list comprises varieties which appear to grade in hardiness with the Wealthy apple:

Späte Amarelle, *Fouchès' Morello*, *Minnesota Ostheim*, *Brusseler Braun*, *Orel 25.*

Among those of exceptional hardiness, and which should be tested along the northern border of the apple belt are: *Riga No. 18*, *Vladimir*, *Bessarabian* and *Schatten Amarelle.*

Propagation.

Budding.—Cherries are propagated for commercial purposes almost entirely by budding. This consists in transferring a single bud of the desired variety to the stock or branch upon which it is to grow. The operation is usually performed during the month of August when (using a nurseryman's phrase), "the bark slips." It is effected by slicing a well ripened bud from a twig of the growth of the same season, and inserting it under the bark of the stock, where it is securely tied. If the operation is successful all the top above the inserted bud is cut off the following spring. By rubbing off and preventing the formation of other wood the whole growth of the stock is directed into this channel. In this way trees of suitable size for orchard planting are produced in two seasons. In the Western States where the snow fall is limited, some objections have been urged against this method of propagation on the ground of the prevalence of root injury, to the more or less tender stocks. In regions of abundant snow fall, as in the Province of Quebec and Eastern Ontario, this objection does not carry the same weight.

Crown Grafting.

Root grafting as ordinarily practised when applied to the propagation of the cherry is attended with little success.

Crown grafting, which is inserting the scion in the crown or collar of the stock, at or a little below the surface of the ground, is in the experience of the writer a much more successful method. This may be done in winter, using stocks which have been stored for the purpose; or early in spring upon stocks already established, and undisturbed in the ground for a year. Prof. Budd claims satisfactory results when the stocks are taken up in the Autumn and grafted in

Fig. 9.

the graft room during winter. Careful comparisons have been made here for the past three years with a view to determine which plan was attended with the best results. The average returns show a gain of over fifty per cent, in favor of *crown grafting*, early in spring, upon stocks in the ground, which had been planted the year previous. A strong growth is obtained the first year, at the end of which the graft may be taken up, and part of the old root cut away. The yearling graft may then be replanted setting it deeper than formerly, so that the scion is brought under ground and offered conditions favourable to the emission of roots. The principal objection to the method is that at the time—early in spring—when this work should be performed, many other duties engage the attention of the fruit grower making it difficult to accomplish in a limited time a large amount of this kind of grafting. The method is one however, that can always be practised to some extent. It will prove of special service to amateurs for whose benefit the following instructions are given :

The stocks should be planted in nursery rows the year previous to the date of grafting. Cut well matured scions in autumn of the growth of the same season, keep these in a dormant condition over winter by packing in forest leaves, or damp sawdust. In this locality the best time for out-door grafting is usually during the first two weeks of April. Figure 9 illustrates the method of crown grafting the cherry, as usually conducted in the graft room ; (a) shows the scion cut wedge shape, (b) the stock with a slanting cleft for the reception of the scion, (c) the scion in position, firmly bound with waxed thread, and (d) illustrates the joint completed by a covering of grafting-wax, to exclude the air.

In the case of out door work the process is essentially the same, except in the manner of tying. Instead of binding first, and waxing afterwards, a firmer joint is made by applying the wax first, and covering this with a cotton bandage which adheres to the wax, and holds the scion in position. It must be remembered in the case of stocks which are in the ground, that the top is cut off at the point indicated in the figure as soon as the scion is inserted, after a little practice this is easily removed by an upward cut, which can be made without disturbing the scion.

Stocks.

The Mazzard cherry (*Prunus avium*) is probably used by nurserymen more than any other as a propagating stock. It is a native of Europe, and is supposed to have given rise to many of our cultivated varieties. All varieties of cherries unite with it readily.

The Mahaleb cherry (*Prunus mahaleb*) is used to a considerable extent, partly on account of its dwarfing tendency, and also because of its adaptability to clay soils, as pointed out by Professor Bailey. (See Bulletin on Native Plums and Cherries.)

The Morello stock (*Prunus cerasus*) has not been largely used by nurserymen chiefly owing to its sprouting habits. It is hardy, however, and can be frequently procured by amateurs, when Mahaleb or Mazzard are not easily obtained.

Wild Red or Bird Cherry (*Prunus Pennsylvanica*) has been successfully used as a budding stock for some years by several experimenters, but its ultimate value for this purpose has not been definitely determined. Most varieties seem to unite with it as readily as with Mazzard. Budded trees of many varieties on this stock in the trial grounds of the Central Farm are making a vigorous growth, apparently having made a perfect union. The ease with which seed of this species can be procured in nearly all parts of the Dominion, as well as its great hardiness, should render it a popular stock for cold climates.

Propagation by Root Cuttings.

When cherries are on their own roots, as when grown from sprouts, they may be multiplied by means of root cuttings. The surface system of roots,—those nearest the top of the ground,—are used for this purpose. These are taken up in the autumn and cut into three-inch lengths, packed in boxes with earth and stored in a cool cellar till spring. When the ground is in proper condition the cuttings are planted in rows, sticking them in a slanting position and covering completely, so that the top end is about an inch below the surface of the soil. Several shoots will usually start; the strongest should be trained up to form the future stem, and all others broken off. Where greenhouse facilities are available, the cuttings may be started during winter with gentle bottom heat in the propagating bench, and set in nursery rows the following spring.

Grafting Wax.

Many receipts are offered for the manufacture of grafting wax. A satisfactory wax for out-door use is made by melting together 5 parts resin, and 2 parts beeswax; to this is added $1\frac{1}{2}$ to 2 parts linseed oil. For winter use in the grafting room the same amount of resin with less oil and beeswax, makes a wax more suitable for indoor application.

A liquid grafting wax is made by melting together 1 lb. white resin and 1 oz. beef tallow; to this, when removed from the fire and partly cooled, 8 ounces of alcohol is added, stirring in slowly. This should be kept in closed cans to prevent the alcohol evaporating.

ERRATA:

Page 10, line eight, Fig. 3: For "Minnesota Southerin," read "Minnesota Ostheim."

Page 12, line seven, Fig. 5: For "Spate Amabelle," read "Späte Amarelle."

CENTRAL EXPERIMENTAL FARM.

DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - CANADA.

BULLETIN No. 18.

LADOGA WHEAT.

FEBRUARY, 1893.

To the Honourable the

MINISTER OF AGRICULTURE.

SIR,—I have the honour to submit for your approval Bulletin No. 18 of the Experimental Farm series, in which I have endeavoured to place before the public in an impartial manner the particulars relating to the introduction and dissemination of the Ladoga wheat, and the efforts which have been made from the outset to obtain information from those most competent to judge as to its quality and from farmers as to its earliness in ripening. I have also embodied the more recent report of Messrs. McLaughlin & Moore, of the Royal Dominion Mills, of Toronto, Ont., on the thorough test made by them to determine the relative commercial value of the flour of this variety of wheat as compared with that of the Red Fife.

I desire to acknowledge my obligations to Messrs. McLaughlin & Moore, also to Mr. J. D. Nasmith, G. Coleman and B. Woodman, who have conducted the baking tests, for the careful and painstaking manner in which the work has been carried out.

I have the honour to be,

Your obedient servant,

WM. SAUNDERS,

Director Experimental Farms.

OTTAWA, February 24, 1893.

CENTRAL EXPERIMENTAL FARM.

DEPARTMENT OF AGRICULTURE,

OTTAWA, - - - - - CANADA.

LADOGA WHEAT.

BY WM. SAUNDERS, *Director, Experimental Farms.*

For many years past the importance of obtaining the earliest ripening varieties of grain which the world could furnish for test in the Canadian North-West, had impressed itself on the minds of many of those who took an interest in that country. In 1882 when the late Charles Gibb, of Abbotsford, Que., visited Russia in company with Pro. J. L. Budd, of Iowa, for the purpose of inquiring into the character and hardiness of the fruits grown in the northern parts of that country, he made inquiries also regarding the early ripening varieties of wheat to be found there. Having carefully studied the character of the climate, he ascertained that the season was short and that the climatic conditions in some parts of Russia closely resemble those which obtain in districts in the North-West Territories of Canada, and finding that some of the wheats in cultivation there ripened very early, he endeavoured to procure samples to bring home with him, but did not succeed in obtaining them. In conversation with him after his return, information was obtained as to the localities and sources where the most promising of the early ripening wheats would probably be found, and as soon as the experimental farm system was inaugurated, early in the winter of 1886, under instructions of the Hon. John Carling, Minister of Agriculture, correspondence was opened with a noted seed dealer in Riga, Russia, Mr. E. Goegginger, who had made a special study of Russian cereals. Samples of the best Red Fife obtainable were sent to him, and he was requested to select from the varieties grown

north of Riga, the earliest sort or sorts to be found, and if possible to secure grain equal in quality to the best Red Fife. He was also requested to interest himself in obtaining for test on the experimental farms samples of other varieties grown as far north in that country as the cultivation of wheat extended, so that opportunity might be had for testing here all the more promising sorts to be found in Northern Russia, with the hope of finding among them a hard wheat of good quality, which would ripen early enough to escape the autumn frosts, which sometimes injure the crop in some parts of the North-West country.

The variety which Mr. Goegginger recommended as most likely to meet the requirements of the case was the Ladoga, grown in latitude 60 near Lake Ladoga, north of St. Petersburg, and by latitude 600 miles north of the city of Winnipeg. This variety is said to be highly esteemed in Russia both for its quality and earliness. One hundred bushels of this wheat was ordered and received in Ottawa early in the spring of 1887, when samples were submitted to some of the leading millers and other expert judges who pronounced it to be a promising wheat which they believed would grade almost as high as No. 1 hard. The kernel was plump, longer than Red Fife but not so bright in colour and it weighed 61 lbs. per bushel. Samples of this grain weighing three lbs. each were distributed for test without delay to farmers in different parts of the Dominion, 277 of which went to Manitoba and the North-West Territories and 1,200 lbs. was forwarded by the Commissioner of Indian Affairs to be distributed among the Indian agencies.

The demand from the North-West for samples of this grain was large and it was found necessary to order another 100 bushels from Riga which was received early in the spring of 1888. 275 reports were received from farmers who had tested the Ladoga in 1887, and 301 from those who tested it in 1888, and these show that the Ladoga had ripened on the average ten days earlier than the Red Fife wherever tested. A bulletin was issued on this subject (No. 4) in March, 1888, giving particulars of such information as was obtainable regarding this wheat to that date.

In order to form a correct judgment as to the quality of this grain as grown in this country, opinions were sought from the most competent judges and boards of experts in the Dominion. The most prominent among the Dominion grain inspectors, the

largest millers, and the Boards of Trade at Montreal, Toronto and Winnipeg were all consulted. Eleven samples of Ladoga, four of which had been grown in Manitoba, four in the North-West Territories, and three in the Maritime Provinces, were selected for scrutiny. The samples sent to each were all out of the same bags, they were sent just as they were received from the growers ; information was given as to the name of the variety, the names and addresses of the parties who had grown the samples, and an opinion asked for as to how these samples would grade in the markets of this country, if offered in quantity, and how they would compare in value with Red Fife. With reference to the purpose of this introduction, I quote the following from the letter which accompanied the specimens, "the object of this introduction is not by any means to displace the Red Fife. I think the growth of that variety should be encouraged in every practicable way, but the Minister of Agriculture desires that an earlier wheat of good quality should be secured to be grown where the Red Fife does not succeed, and thus discourage and prevent as far as is practicable the introduction of soft and inferior varieties of wheat, so that the present high standard of our North-West grain may be generally maintained." The opinions given on these samples—which were identically the same in each case—were most varied and conflicting. The same sample was pronounced "hard" by one board of experts, "soft" by another, "hard" by a third, but "worth 5 cents a bushel less than No. 1 hard," while a fourth judge pronounced it as "extra No. 1 hard."

Samples of the same lot were submitted for analysis to Mr. F. T. Shutt, Chemist of the Dominion Experimental Farms, and the results of his analyses published in Bulletin 4 show that the better samples of Ladoga contained as large a percentage of gluten as the best Red Fife, and the quality of a hard wheat is believed to depend mainly on the proportion of gluten it contains.

In November, 1888, sixteen bushels of Ladoga wheat which had been grown at the Experimental Farm at Indian Head were taken to the roller mill at Fort Qu'Appelle, N.W.T., with a similar quantity of Red Fife which had been grown in an adjacent field. The flour of the Ladoga, when compared with the Red Fife, was found to have a yellow shade. Several sacks of flour from both these varieties were forwarded to Ottawa, and bread carefully made

from each under my own supervision. The Ladoga was found to produce a drier flour than the Red Fife, and 100 lbs. of the Ladoga flour produced 2 lbs. more of bread than the same quantity of the other. The bread made from both samples had a yellowish tint, but the yellow colour was more pronounced in the bread made from the Ladoga flour. Samples of this bread were submitted to the members of the Committee on Agriculture of the House of Commons then in session, where they were both pronounced of good quality.

A sack of each sort of flour was sent to two of the leading bakers in Ottawa, who tested it carefully and submitted reports. One stated that the Ladoga was a stronger flour than the Red Fife and would make more bread to the barrel, but the colour of the bread made from it was not so good; the other was also of opinion that the Ladoga was the stronger flour of the two, but being darker in colour would not command so high a price as the Red Fife. Samples of bread made from the Ladoga were sent to a number of people of good judgment in Ottawa, by whom it was pronounced to be of good quality.

In summing up the evidence brought together in Bulletin 4 I used the following words, which I thought were justified by the facts presented :—"The better samples of Ladoga are fully as rich in gluten as the best Red Fife, and while the cultivation of the Red Fife should be recommended in every section of the North-West, where it is likely with early sowing to escape the autumn frosts, the growth of the Ladoga may be safely encouraged wherever the ripening of the Red Fife is uncertain, without incurring the risk of materially lowering the reputation or the general quality of Canadian hard wheats."

In the annual reports of the Experimental Farms for the years 1889, 1890 and 1891, further particulars were given of the testing of this wheat, and it is shown that the quality of early ripening has been maintained throughout. Many efforts were made during the past two years to secure a sufficient quantity of Ladoga to make a thorough test at one of the larger mills as to the quality of the flour which could be made from it, as the early tests made in a small way were held to be insufficient and unreliable. Finally Messrs. McLaughlin & Moore, of the Royal Dominion Mills, of Toronto, agreed to make a thorough test if a car load of this

wheat could be procured for the purpose. On learning that it could be got in the Prince Albert district, where some of the farmers had grown Ladoga very successfully for several years, Mr. A. Mackay, Superintendent of the Experimental Farm at Indian Head, was requested to visit that locality early in the year and purchase the necessary quantity of pure Ladoga. This reached Toronto early in April, and on the 28th of that month the grinding was begun. I was present during the greater part of the day and saw the working of the wheat and was satisfied that the test was fairly conducted.

Several of the leading bakers in Toronto were supplied with the flour and several tests were made with it, and our chemist, Mr. F. T. Shutt, was sent to Toronto to be present at some of these tests. The following report has been submitted by Mr. Shutt :—

Wm. Saunders, Esq.,

Sir,—I beg to report as follows regarding the Ladoga baking test conducted in Toronto last May :—

The wheat was ground by Messrs. McLaughlin & Moore, Royal Dominion Mills, Toronto. In an interview Mr. McLaughlin expressed himself respecting the milling of Ladoga and the quality of the flour in the following terms : "Compared with Red Fife it grinds 'tough,' reducing the capacity of the mill—thus the output per hour was :—

Ladoga........................	16·3	barrels.
Red Fife........................	18·1	"

These results, however, would not have been so adverse to Ladoga if the mill were run with it, say for a week. The present trial was for nine hours only. The cleaning process or separation of bran is more difficult in the case of the Ladoga, though in this respect as well as in the grinding it ranks ahead of 'goose' wheat. It would yield about the same quantity of flour per bushel as No. 1 Hard, in which also the percentages of 'Bakers' strong' and Low grade are similar to those from No. 1 Hard. It contains about the same percentage of gluten as No. 1 Hard. The flour is yellow compared with that from No. 1 Hard. Doubtless the flour would give better results after being allowed to age."

Through the courtesy of Mr. J. D. Nasmith, baking trials were made at his bakery, Adelaide Street, Toronto.

The first three experiments were conducted by Mr. Nasmith on 4th, 5th and 10th May. He found that the third trial yielded

much whiter bread than the first, owing to a modification in the method and time of working the sponge and dough. Mr. Nasmith obtained bread from Ladoga, at the third trial, which but for a slight yellow tinge he considered equal to that from "Queen" (Patent) brand. He further is of opinion that it is a strong flour, and that the yellow colour may be dissipated to a great extent by allowing fermentation to proceed longer than usual. The sponge of Ladoga works quicker than that of Red Fife. In a comparative test Mr. Nasmith obtained from 100 lbs. of "Queen" flour, 147 lbs. of bread; from 100 lbs. of "Ladoga" flour, 152 lbs. of bread.

The following trials were made under my own supervision. The weights of flour, yeast, salt and water used, as well as of the sponge, dough and bread were carefully recorded. The baker used a sufficient quantity of water, according to his own judgment, to bring the sponge and dough in each case to the right consistency; the weight of the water used being noted. The sponge in each case was set for eleven hours, the initial temperature being 76° F. The temperature of the bakehouse ranged from 70° to 72° F. throughout the night.

The "Queen" brand.—This rose well in the sponge and improved in the pans, and the bread was very satisfactory in all respects. From 100 lbs. of flour, 140 lbs. 8 oz. of bread were baked.

The Ladoga flour.—At the end of the setting period (11 hours) the sponge was much "slacker" than that of the "Queen." It had evidently been allowed to ferment too long and had become "spent." It would not "improve" or rise in the pans, and the resulting bread was yellow and "flat" compared with that from the Queen flour. From 100 lbs. of the flour 145 lbs. 13 oz. of bread were obtained.

I would very briefly sum up as follows:—

1. That it is evident that the right conditions for obtaining the best results in baking Ladoga are not as yet well understood. Good, well risen white bread has been baked from Ladoga flour which on another occasion has yielded flat, heavy, yellowish bread. The public at present demand a white bread, and it is chiefly on this account, I think, that the bakers are averse to Ladoga flour—the bread from it usually having a yellowish colour.

2. The physical character of the gluten is different from that of the Red Fife. It is somewhat inferior in colour and elasticity, and is more sticky. Age would most probably improve its quality. In percentage of gluten, however, it is fully equal to Red Fife—see Bulletin 4, Experimental Farm series.

3. The Ladoga is drier and consequently takes up more water and yields a larger weight of bread than the Red Fife flour. This I surmised from my analyses of the Red Fife and Ladoga flours given in the Bulletin above mentioned.

Your obedient servant,

FRANK T. SHUTT,

Chemist Dominion Experimental Farms.

Ottawa, January 2nd, 1893.

On the 9th of May, Mr. McLaughlin wrote as follows :—"Mr. Coleman has tried the flour, so has Mr. Nasmith, but neither have yet made tests satisfactory to themselves. So far as we have seen of the bread it looks as if the colour was going to prove very yellow and the strength better than we anticipated, but nothing positive can be said until these bakers have made satisfactory tests." On the 10th he says :—"In our yesterday's letter we said that so far as we had yet seen of the Ladoga bread it was going to prove very yellow . To-day we have samples from both bakers which are surprisingly different from the samples on which we based the "very yellow" opinion. Mr. Nasmith, I think, intends sending you some loaves of bread which if they reach you in good order, will do something to confirm your faith in Ladoga. We shall not venture any further opinion until the bakers have made their final tests." On the same day Mr. J. D. Nasmith write as follows :—"I sent you to-day by express three loaves, two from the Ladoga flour, the other one is from McLaughlin's 'Queen.' The first comparative trial a week ago was suprising, establishing strength enough, but such a very yellow colour as I never saw before in bread. To-day's sample if it reaches you in time, I know will gratify you as it did me, I did not at all anticipate such results from first trial." When this bread arrived I was absent from home and did not return for several weeks when the bread was spoilt. Those who saw it and tested it while fresh pronounced it excellent.

Nothing further was heard on this subject until 14th June, when Mr. McLaughlin wrote again as follows :—"We have now had sufficient experience of the Ladoga flour to satisfy us that it is never going to be a favourite with bakers. Nasmith has not been able to repeat the loaf he sent you, and Coleman condemns it in unstinted terms, a third man, B. Woodman of Parkdale, to whom we sent some had quite as bad an experience as Coleman. These are the only three to whom we have sent the flour. Certainly the bread—all but that one sample of Nasmiths—was unfit for Toronto trade."

Mr. McLaughlin's final report on this subject was written on the 25th August, and reads as follows :—

TORONTO, 25th August, 1892,

Prof. WM. SAUNDERS,
Director Dominion Experimental Farms,
Ottawa.

DEAR SIR,—On the 28th April last, we ground 600 bushels Ladoga wheat shipped to us from Prince Albert, N.W.T.

The wheat was in good condition, fairly plump, free from smut or frost and very uniform.

In grinding it worked quite different from ordinary Manitoba hard wheat, being harder to reduce and requiring more power. In this respect it resembled "goose" wheat more than any other variety.

We sent some of the "Patent" and some of the "Strong Bakers" flour to different bakers in Toronto, telling them what it was, and requesting them to be as careful in their baking tests as we had been in milling it.

In every test the flours were pronounced inferior to the flours from ordinary No. 1 and No. 2 hard Manitoba wheat.

In all cases the deficiency in strength, the very yellow colour, and the coarse texture of the bread were the evils complained of.

No baker who tested it could be persuaded to buy the flours afterwards, even at a considerable reduction in price from the price of flours similarly made from No. 2 hard Manitoba.

Later tests, after the flours had been six weeks old, resulted no better.

Baked as household flour, the Ladoga Patent and Strong Bakers worked fairly and made bread that was up to the quality of much that is used in some places, but not good enough for people who are particular as to appearance as well as taste.

Our different experiences with this flour lead us to this conclusion.

Good unfrosted Ladoga wheat, such as the lot we ground, will make better flour than No. 2 regular Manitoba wheat, but not as good as No. 1 regular Manitoba.

We still have some of both grades of the Ladoga flour on hand, which we would be pleased to dispose of to any one who wished to test it further.

We are yours very truly,

McLAUGHLIN & MOORE.

From the facts submitted it would appear that while it is possible to make good bread from Ladoga flour it is much easier to make bread of an inferior quality, and unless the proper methods for treating this flour to procure uniformly good results could be ascertained it is not likely that Ladoga will be acceptable either to millers or bakers, as long as the flour of the Red Fife is obtainable. Hence wherever Red Fife can be ripened, the efforts of those settlers engaged in wheat growing in the North-West should be directed to its production in the greatest perfection by early sowing and a proper preparation of the soil. It is to be regretted that the Ladoga wheat has not in quality more fully realized the hopes which were first based on it. Since Bulletin No. 4 was published it has been found that the gluten in different varieties of wheat, although responding alike to chemical tests, varies in its physical properties of toughness and elasticitity and that in these particulars, the gluten in Red Fife is superior to that in most other wheats.

The presentation of this case of the Ladoga would not however be complete without quoting from some of the letters which have beén received in favour of this grain. It is undoubtedly a week or ten days earlier in ripening than Red Fife and there is no early variety among all the hard spring wheats which we have tested which has more good points than Ladoga. Some of the varieties imported from India are as early, but they are such poor yielders that no farmer would care to grow them, and no sufficient quantity has been grown here to admit of their being tested by the millers.

Many cross-bred varieties have been produced at the Central farm, between Red Fife and these early sorts with the hope of originating new wheats equal in quality to Red Fife and earlier. Until these new sorts are multiplied and their relative value ascertained, settlers in the Canadian North-West would do well to devote their attention to the growing of Red Fife, and place it under such conditions as to give it every chance of maturing since no other wheat is yet to be had which will give the same satisfactory returns, both for home and foreign trade.

As samples of testimony form settlers and others in favour of Ladoga the following are submitted and many more such might be given. Mr John Eccles of Stony Plain, Edmonton, North-West Territories, writes on March 7th, 1892, as follows: "I sowed a couple of acres of Ladoga last year on the same day as my Red Fife, and reaped it 14 days earlier. It was a splendid crop perfectly free from smut. I consider it a first class wheat, I had a grist ground at the mill, and I never want a better quality of flour, notwithstanding the reports to the contrary."

Mr. Henry H. Hayward, of Hayward, Assa., writes under date of March 26th, 1892, and says: "In the spring of 1889 I sowed a 3-℔. sample of the Ladoga wheat which you were kind enough to send me, and in the fall of last year (1891) I thrashed 174 bushels, the result of the 3-℔ sample. The 19th of this month I took to the roller mills at Fort Qu'Appelle 51 bushels to be tested as to what sort of flour it would make. The amount I received in flour was 38 ℔s. of the best, and about 3 ℔s. of poor grade per bushel of 60 ℔s. I may say that the sample of wheat was a fair one, there being no trace of smut in it. The grain was much lodged by a storm which caused great waste in harvesting, yet I thrashed 35 bushels to the acre." A sample of the flour was sent by Mr. Hayward of that part of the grist which was supposed to be perfectly pure, and it appeared to be very good, but was a little yellow in colour.

Mr. Alex. McGibbon, Inspector of Indian Agencies, writes on November 12th, 1892, from Onion Lake Reserve, 100 miles north-west of Battleford, and says: "I take the liberty of sending you a sample of Ladoga wheat grown on this Agency. It was tried for the first time this year. The Indian fields gave a return of 12 bushels per acre, but it was badly damaged by gophers, the season being very dry. Half an acre sown by the Agent in his own field,

and which received attention, gave a return at the rate of 44 bushels per acre. The whole of this lot is equal to the sample I send you. It was sown on the 22nd of April and harvested on the 3rd of September." The sample sent by Mr. McGibbon was very fine and plump.

The Agent at Onion Lake Reserve, Mr. G. G. Mann, in a recent report to the Department of Indian Affairs, says: "All the wheat was saved without damage by frost, the yield being very poor, with the exception of the few bushels of Ladoga wheat, which turned out fairly well. In consequence of this I have asked in my 1893 estimates for a supply of 200 bushels of Ladoga for seed, which, if supplied, will, I am certain, turn out very well, as it ripens so much earlier than the old grade of wheat there would be no danger from frost." Favourable reports have also been received from other Indian Agencies in the north concerning the successful growth of this wheat.

I am indebted to Mr. C. C. Chipman, Commissioner for the Hudson Bay Company, for the privilege of sending to a number of the posts of that company in the far northern districts of the Dominion, samples of grain of one pound each for test and report. These were sent in the autumn of 1891 to be grown in 1892. The officer in charge of Fort Vermillion, Athabasca District, about 520 miles north-west of Calgary, writes as follows: "The seed was sown on the 14th of May last and harvested on the 23rd of August. There was no rain whatever for three weeks after the seed was sown. The Red Fife did not head out at all; the yield of the Ladoga was 12 lbs., weighing 60 lbs. per bushel; Bonanza oats, 9 lbs.; Prize Cluster oats, 7 lbs.; Rennie's Improved Six-rowed Barley, 16 lbs.; Spring Rye, 18 lbs." Through the kind courtesy of Mr. Chipman I have received samples of these different sorts of grain.

Samples have also come in from the same source from Fort Simpson in the Mackenzie River District, about 750 miles north-west of Calgary. The officer in charge of that post writes as follows: "The kinds of grain sown were Ladoga wheat, Rennie's Improved six-rowed barley and Bonanza oats. The two latter never ripened but the wheat yielded 12 lbs. of good ripe grain. The date at which these varieties were planted here was the 7th of June and the wheat was harvested on September 22nd. The Ladoga in this instance weighed 62¼ lbs. per bushel.

A very fine sample of Ladoga wheat was received last year grown at Dunvegan in the Peace River District, about 340 miles north-west of Calgary, which weighed 64 lbs. per bushel. A sample has also been received grown at Isle à la Crosse, about 170 miles north of Prince Albert, weighing 64 lbs. per bushel. No other wheat has ever given such results as these in those distant northern regions.

While these tests and experiments with the Ladoga have been in progress, a large acreage has been devoted on each of the Experimental Farms at Indian Head, North-west Territories and Brandon, Manitoba, to the growth of pure Red Fife, for the purpose of supplying farmers whose seed had become mixed, with pure grain for a fresh start; and it is proposed to continue this work on a still larger scale in future, so that the means may be afforded of renewing the stock of this valuable grain from time to time from a pure source. Many farmers in the west have had forwarded to them from Ontario during the past few years, samples of eastern soft wheats for trial, and in this way White Russian, Colorado, Red Fern, Golden Drop and other varieties have been introduced and in some localities grown to a considerable extent. Although these varieties soon harden in that climate and some of them are then difficult to distinguish from Red Fife, they do not contain the quality of gluten which is found in the Red Fife; and any considerable admixture of any inferior sort will sooner or later lower the character and probably reduce to some extent the price paid for hard wheats. It has been supposed by some people who have not inquired very closely into the matter and who are not conversant with the peculiarities of the different varieties that all the soft wheats grown in Manitoba and the North-west Territories are Ladoga. The Ladoga is not and never has been in our experience a soft wheat and there is no doubt that the quantities grown in the North-west of the other varieties referred to far exceed the quantity of Ladoga which has been produced. While the idea of growing Ladoga wheat as a competitor with Red Fife for export or the general home trade, should be abandoned, there is no doubt that the flour of the Ladoga makes excellent and nutritious bread for home use, and where wheat growing is carried on in the more northern districts in a limited way for home consumption, and where Red Fife seldom ripens, or on the Indian Reserves where a yellow tint in the bread is not a matter of so much significance, the Ladoga wheat will still prove a most useful and desirable variety.

DEPARTMENT OF AGRICULTURE.

CENTRAL EXPERIMENTAL FARM.

OTTAWA, CANADA.

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BULLETIN No. 19.

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GRASSES: THEIR USES AND COMPOSITION.

SEPTEMBER, 1893.

PUBLISHED BY DIRECTION OF THE HON. A. R. ANGERS, MINISTER OF AGRICULTURE.

To the Honourable

THE MINISTER OF AGRICULTURE.

SIR,—I have the honour to submit for your approval Bulletin No. 19, of the Experimental Farm series, which has been prepared at my request through the joint labours of Mr. Jas. Fletcher, Botanist and Entomologist, and Mr. F. T. Shutt, Chemist, of the Dominion Experimental Farms.

In this Bulletin will be found information on the characteristics and composition of a large number of grasses, most of which have been grown under the care of the botanist, at the Central Experimental Farm. Many of these are natives of the Canadian North-west, and among them are several which have been tested for several years at the experimental farms at Brandon and Indian Head, and give promise of being very useful for fodder purposes to those engaged in stock raising in Manitoba and the Territories. The illustrations given will aid the farmer in recognizing these useful plants. The relative usefulness of these different grasses depends much on their nutritive constituents. The proportions of these are fully set forth by the chemist in the tables of analytical results, which contain the information which will enable the reader to judge of the comparative value of the species referred to from the North-west, and also of many other species of grasses from Europe and elsewhere, some of which are in use as fodder grasses for hay and pasture lands in many parts of Canada.

The importance of the cattle industry is very great, and it is believed that the information given in this Bulletin will be very useful to stockmen and farmers generally.

I have the honour to be
Your obedient servant,
WM. SAUNDERS,
Director Experimental Farms.

OTTAWA, August 4, 1893.

GRASSES:

THEIR USES AND COMPOSITION.

BY

JAMES FLETCHER, F.R.S.C., F.L.S.,

Entomologist and Botanist, Dominion Experimental Farms,

AND

FRANK T. SHUTT, M.A., F.C.S., F.I.C.,

Chemist, Dominion Experimental Farms.

It is needless to point out to farmers the enormous importance of the various members of the grass family, which provide food for man and the different kinds of live stock. All the cereals, including Indian corn, wheat, barley, oats, etc., are true grasses; some of them, of course, are of very much more value than others, and probably the good qualities of many of the best have been already recognized; but there are in every country many species of value concerning which nothing or very little is known. The present Bulletin contains notes concerning the agricultural value, as well as a tabulated statement of the composition, of many species of imported and native grasses. Part I treats of species which have been under cultivation and examination at the Central Experimental Farm during the past four years, some of them native species of which previously the agricultural value had not been investigated. Part II treats of grasses from Manitoba and the North-west Territories. There is a general impression among farmers that because a grass is wild, therefore it is useless or at least very much less useful than the imported kinds. This impression, however, is largely erroneous; for it has been found that many of the best European grasses will not thrive in the Canadian climate, owing either to the heat of summer or the cold of winter. Now the bulk of grass seed imported into this country comes direct from Europe, and, as a matter of fact, a farmer wishing

to purchase grass seed other than Timothy, can seldom obtain any excepting that of European grasses. It should not be forgotten, however, that all the grasses which farmers have now under cultivation were once wild grasses and are so still in their original homes.

We have found that several of our native species are well worthy of cultivation as hay and pasture grasses, and are as well suited, if not better, for paying crops in certain parts of Canada as any imported species which can be grown. The requirements of a good grass are: 1st. That it should produce a heavy crop, so as to pay well for the use of the land; 2nd. That it should be hardy, so as to be uninjured by the climate; 3rd. That it should be rich in albuminoids or flesh-forming constituents, and poor in hard, indigestible fibre; and, 4th. That it should be palatable, so as to be relished by stock.

There are no less than 300 kinds of grasses found wild or naturalized in Canada, varying much among themselves in the characters given above. In the experiments here referred to, a few grasses only are mentioned, out of a collection consisting of about 250 different kinds which have been grown and are now being studied. When further data have been obtained, reports will be made public of such information as it is deemed will be of value to the farmers of Canada, either in drawing their attention to the particular points of value in certain grasses, or indicating those species which have shown themselves unsuitable for cultivation as remunerative crops.

It may be noted that some grasses, as, for instance June grass, have great value for pasturage, springing up again rapidly when eaten off, while they give but a light crop of hay, and on the other hand some grasses, although very valuable as hay grasses, provide but a small quantity of food in a pasture, as is the case with Timothy.

There are few farm crops more susceptible to environment than the grasses; many of them, though meagre in growth and poor in quality when wild, have been found to be peculiarly responsive when given thorough cultivation in a rich soil, improving vastly both in yield and nutritive qualities. There are ample scientific data to substantiate the above statement: hence the value of a more careful and liberal culture of pasture and meadow grasses than that at present in vogue in many parts of the Dominion, is obvious.

FODDER CONSTITUENTS.

The analysis of a grass or other fodder includes a determination of (1) water; (2) nitrogen, from which the amount of albuminoids is calculated; (3) fat, or oil; (4) nitrogen-free extract, or carbohydrates; (5) fibre, or cellulose; and (6) ash, or mineral matter.

The nature and function of these constituents, or nutrients, as they are usually called, have been dwelt upon at length in former publications.* It will suffice here to epitomize.

WATER.—Water assists in the preservation of the succulency and palatability of a fodder, and its withdrawal as the plant matures is usually accompanied by an impaired digestibility of the food. In proper proportions, water is essential to the well-being of the animal—to the solution, digestion and assimilation of its food, and to the excretion of its waste products. Since, however, it is so plentiful in nature, it cannot, when compared with other food constituents, be in itself considered a nutrient to which a pecuniary value can be assigned.

ALBUMINOIDS OR PROTEIN.—Under these terms are collected the substances that constitute the nitrogenous portion of the fodder. They are by far the most important and valuable of all the nutrients, since they largely assist in the formation of blood, muscle, bone; they are consequently necessary to the production of milk and flesh. Hence they are known as "flesh-formers." The wastes of the tissues which daily ensue from bodily activity, are repaired from and replaced by the albuminoids of the food. They are under certain circumstances converted into fats of the body, and at times also serve for the production of heat and muscular strength in the animal. Since they are absolutely necessary, not only for milk and beef production, but also for the maintenance of life, the albuminoids cannot be replaced in a ration by any of the other nutrients.

Although all the nitrogen of the present analyses is returned as albuminoids, it should be stated that during the earlier periods of growth a small percentage of it exists (as non-albuminoid nitrogen)

*Report of Chemist in Reports of Dominion Experimental Farms for 1890 and 1892;—Report of Dairy Commissioner, 1891-2, page 102 et seq., etc.

in compounds the exact food value of which has not as yet been determined, but which is usually held to be somewhat less than that of the true albuminoids.

FAT.—This constituent ranks next to the albuminoids in nutritive value. It is readily converted into adipose tissue in the animal. It is one of the chief heat and energy producing ingredients of fodders. It aids the digestion and assimilation of the albuminoids and preserves them in the animal economy from undue waste.

The seeds of many plants are rich in fat or oil. In stems and leaves the percentage is usually very much less.

In ordinary analyses of fodders, the chlorophyl (or green colouring matter), together with other substances extracted by ether, is included in the percentage of fat recorded. Hence, it is sometimes indicated as "crude fat."

NITROGEN-FREE EXTRACT OR CARBOHYDRATES.—Sugar, starch, gum and allied substances are here included. They are known as the "fuel ingredients," supplying, by their combustion in the blood, energy, either as heat or power for work. They are not stored up by the animal.

FIBRE OR CELLULOSE.—Under these terms are designated the substances that constitute the framework of the plant. In chemical composition they are very similar to the carbohydrates mentioned above, and the physiological functions of digestible fibre are likewise of the same character. As a rule, the fibre is much more digestible in the young plant than in the more mature, in the latter it has largely become converted into lignin, which is of a woody nature and for the most part passes through the animal unchanged. Fibre is the least valuable of all the food constituents.

ASH OR MINERAL MATTER.—The inorganic or mineral matter of plants is taken by them from the soil. It consists chiefly of lime, magnesia and potash combined with phosphoric, carbonic and other acids. The composition and amount of ash in plants vary widely, depending largely upon the constituents of the soil and their solubility and upon the nature of the plant. The mineral matter of bones, and the small quantity present in the other tissues, is derived from this source. All food rations contain sufficient to supply the requirements of the animal, hence no particular value is assigned to the "ash" of a fodder.

I.—GRASSES GROWN AT OTTAWA.

In the tables of analyses are to be found the percentages of the nutrients in the green fodders at the time of cutting, and also the figures that represent the composition of the water-free substance—the latter data being calculated and inserted for the sake of facilitating a comparison between the nutritive values of the grasses.

Many of the grasses have been analysed at two stages of growth. The data thus obtained enable the reader to judge of the period when the grass is most nutritious, and consequently of the best time to cut for hay.

The numbers preceding the names of the grasses in the following pages refer to the analyses given in the tables on pages 30 to 35. The analyses of a few kinds of well known grassess are not yet completed; but as some account of them will be looked for in this bulletin, they are put in their alphabetical order without numbers.

Nos. 1 & 2.—AGROPYRUM CANINUM, R. & S. (Bearded Wheat Grass).

A native perennial grass found growing in clumps on gravelly banks and prairie benches, about 4 feet in height. Although of the same family as Quack grass, it never produces the running root-stocks which make this latter such a pest to the farmer. When bruised it has a strong odour, but is well liked by cattle. Flowering period, July 1 to 15. Analysis shows it to be rich in albuminoids during the early stages of growth.

Nos. 3 & 4.—AGROPYRUM GLAUCUM, R. & S., var. OCCIDENTALE, V. & S. (Colorado Blue-stem).

Native, perennial. Height, 2½ feet. One of the most valuable grasses of the western plains, where it is the chief grass of the cattle ranches. It produces an abundance of fine leaves from running root-stocks and seeds freely. Flowering period, July 5 to 15. Not a heavy yielder; best suited for pasture. Owing to its running root-stocks, it cannot be recommended where alternate husbandry is practised. The analytical data show that it makes a highly nutritive feed.

No. 5.—AGROPYRUM REPENS, Beauv. (Quack, Scutch or Couch).

Well known throughout Canada as an agricultural pest on account of its vigour of growth and creeping root-stocks, which render it

difficult to eradicate. When green it is much relished by cattle, and if cut when in flower, produces rich hay. After a few years, however, it fills the soil with matted roots and yields sparingly, so that it can only be regarded as a weed. From the analysis, it is apparent that the grass has considerable nutritive value.

No. 6.—Agropyrum tenerum, Vasey (Western Rye Grass).

Native, perennial, growing in low lands and on prairie benches, from Manitoba west to the Pacific. Height, 3 to 4 feet. Flowering period, July 1 to 15. This grass has succeeded remarkably well under cultivation and is one of the best western hay grasses, producing a large number of leaves, and straight, slender stems. It is an early grass and does well on heavy soil, even when impregnated slightly with alkali. Judging from its composition, it compares very favourably with the other members of the family, being of good quality and nutritious.

Fig. 1.—Red Top.

No. 7.—Agrostis vulgaris, With. (Red Top).—Fig. 1.

Introduced, but now spontaneous everywhere, perennial, particularly suitable for low lands, where it should always find a place in permanent pasture mixtures. It makes a firm sod, and in good soil produces a fair crop of fine, soft hay. Flowering period, June 28 to July 10. Height, 2½ to 3 feet. Undoubtedly a valuable grass, but not so high in albuminoids as some of the other grasses here treated.

No. 8.—Agrostis dispar, Mx.

Very similar to the above in habit and composition, but of freer and more vigorous growth.

No. 9.—ALOPECURUS PRATENSIS, L. (Meadow Fox-tail).

Introduced from Europe. An early, perennial grass of good quality, but requiring a rich soil, moist climate, and three or four years to come to perfection. Does not produce a heavy crop of hay, but is valuable for pastures on account of earliness, rapidity of growth after cutting and rich aftermath. It is grown to some extent in the Maritime Provinces under the name of "French Timothy." Flowering period, June 10 to 20. Height, 2½ to 3 feet.

ANTHOXANTHUM ODORATUM, L. (Sweet Vernal Grass).

A very sweet-scented introduced grass, highly esteemed in Europe for its earliness and the sweetness it imparts to hay. Our experiments with it in this country will not justify our recommending it, as it has not proved hardy enough.

AVENA ELATIOR, L. (Tall Oat Grass).

A tall slender European grass, useful in permanent pasture mix tures, but not suitable for growing alone. It flowers about the same time as Timothy and produces a good aftermath of slender leafy stems. Height, 3 to 4 feet. This grass is also sometimes called *Arrhenatherum avenaceum*, Beauv.

AVENA FLAVESCENS, L. (Yellow Oat Grass).

A slender grass, introduced from Europe, highly spoken of for mixtures, but of small size and slow growth. Height, 3 feet.

No. 10.—BOUTELOUA OLIGOSTACHYA, Torr. (Grama Grass).

A small native perennial grass of the western prairies. Highly nutritious and much relished by cattle. Not adapted to cultivation in the east, but stated by Dr. Vasey to be the main reliance of stock-feeders on the arid plains of the Western States. Flowering period, July 1 to 15. Height, 1 foot. Our analyses of plants grown at Ottawa confirm the high opinion expressed above.

No. 11.—BROMUS CILIATUS, L. (Fringed Brome Grass.)

Native, perennial. A tall, leafy grass found in woods and along river banks. Not generally recognized as of much agricultural

value, but reported as a promising hay grass in Manitoba and the North-west Territories. Flowering period, July 10 to 20. Height, 3 to 5 feet.

No. 12 & 13.—Bromus inermis, Leyss. (Awnless Brome, Austrian Brome Grass).—Fig. 2.

Fig. 2.—Awnless Brome Grass.

Introduced, perennial, conspicuous for its free leafy growth and tall stems, which bear an abundance of seed. Very hardy, early, a heavy cropper and producing a good aftermath of succulent leafy shoots Reports received from all parts of Canada speak very highly of this newly introduced grass. It thrives well in any loose soil and withstands droughts, but produces a much heavier crop in rich, damp land. We consider this one of the most valuable of the introduced grasses, both from its feeding qualities as evinced by the analysis, and from its free luxuriant habit of growth. It must, however, be remembered that it makes long underground rootstocks which are difficult to eradicate. Flowering period, June 25 to July 10. Height, 3 to 5 feet.

Bromus secalinus, L. (Chess).

This grass is grown in the Pacific States on alkaline lands, where it is said to produce a heavy crop of good hay. In the East it is considered a pernicious weed.

Chess is an annual, the seed germinating in the autumn and flowering stems appearing the next summer. Height, 2 to 3 feet. The idea that this grass is degenerated wheat is entirely without foundation.

No. 14 & 15.—Bromus Pumpellianus, Scrib. (Western Brome Grass).—Fig. 3.

Fig. 3.—Western Brome grass.

A native, perennial, found on river banks and coulee margins from Manitoba to British Columbia. This is a valuable grass, producing an abundance of leafy stems, continuing in flower a long time and giving a heavy aftermath. It spreads rapidly from the root and, with the exception of a somewhat smaller yield, closely resembles in all particulars the Awnless Brome grass. Flowering period, June 20 to July 15. Height, 3 feet.

No. 16.—Bromus segetum, Schl.

An introduced annual from Mexico. This grass will bear twice cutting and will then seeditself for the next year. The yield of hay is not heavy enough to give it much agricultural value. Flowering period, July 1 to 10. Height, 2 feet. The analysis of this grass, made while in flower, proves it to be especially rich and nutritious.

No. 17.—Buchloe dactyloides, Engelm. (Buffalo Grass).

A perennial grass of small size, forming thick mats of hair-like foliage, three or four inches in depth. Found throughout the arid region of the western plains of the United States, where it is highly esteemed from the important part it plays in feeding and fattening vast herds of cattle. It is probable that it will be found along the southern border of our prairie region. This is known distinctively as the "true Buffalo grass" from the supposition that it was the favourite of the American Bison. This grass is not suitable for cultivation in the east as it starts very late in spring, not showing a sign of life until June. In the west it thrives on all classes of soils

and provides a rich and palatable food during the greater part of the year, stock relishing it equally well in the dry or fresh condition. Flowering period, June 20 to September.

No. 18.—CERATOCHLOA AUSTRALIS (Southern Brome Grass).

Seed imported from Germany. This is probably identical with Schrader's Brome grass, which is again supposed to be the same as *Bromus unioloides*, Willd.. A free growing annual, which produces a large amount of succulent fodder of rich quality. It shoots up again quickly after cutting and continues growing until killed by winter. Flowering period, July 5 to 20. Height, 2 to 3 feet.

No. 19.—CINNA PENDULA, Trin. (Drooping Reed Grass).

A slender, leafy, native grass, found in swamps and mountain woods. Difficult to cultivate and therefore of no agricultural value, although its analysis shows it to be a rich grass. Flowering period, July 5 to 20. Height, 2½ to 3 feet.

DACTYLIS GLOMERATA, L. (Orchard Grass, Cock's Foot).

A valuable agricultural grass where it will grow. Originally introduced from Europe, where it is one of the most highly esteemed of all fodder plants. Particularly suitable for growing in orchards and under trees. It requires rich soil, on which it produces a heavy crop both of hay and pasture. The hay must be cut early, or it becomes hard and woody. In pastures also it requires to be fed closely. Flowering period about the same as Timothy and Clover. Height, 3 feet.

No. 20.—DESCHAMPSIA CÆSPITOSA, Beauv. (Tufted Hair Grass).

Native, perennial. A beautiful grass, but of no economic value, with very short leaves and tall, feathery panicles of silvery flowers. Flowering period, July 1 to 10. Height, 2½ feet.

No. 21.—DESCHAMPSIA CÆSPITOSA, Beauv., var. BOTTNICA, Vasey (Rocky Mountain Hair Grass).

This variety, although of no special agricultural value, is far superior to the above. It grows in tufts like the last, but bears fewer flowering stems and many more and longer (18 inches) dark green leaves. Flowering period, July 1 to 15. Height, 3 feet.

No. 22.—Deyeuxia Canadensis, Hook. (Canadian Blue-joint).—Fig. 4.

Fig. 4.—Canadian Blue-joint.

Native, perennial. This is a very leafy grass, suitable for all low lands. It grows naturally in ditches and marshes, but has succeeded well under cultivation. Its character of remaining green after the seeds are ripe gives it a special value. It is a heavy cropper and is worthy of extensive cultivation, being eaten by all stock with avidity, both in its green state and as hay. Flowering period, July 1 to 15. Height 4 to 5 feet.

Very similar to this is the Northern Blue-joint, *Deyeuxia Langsdorffii*, Kunth. abundant in the Lake Superior region but occurring, like Canadian Blue-joint, from the Atlantic to the Pacific.

No. 23.—Deyeuxia neglecta, Kunth. (Neglected Blue-joint).

Native, perennial. This valuable grass of the prairies has succeeded well under cultivation, producing great quantities of long, fine leaves and seeding freely. It forms a large proportion of the grass of the prairies in some districts, and Mr. Bedford, Superintendent of the Experimental Farm for Manitoba, states that, although the hay is rather coarse, ponies will wander long distances cropping the dry stems in preference to many other grasses. Flowering period, June 25 to July 10. Height, 3 feet. Analysis shows it to possess nutritive qualities of a high degree.

No. 24.—Eleusine Indica, Gærtn. (Crow-foot, Yard Grass).

An annual introduced from Asia, producing a medium crop of rather coarse fodder. It probably will not take the place of several other annual grasses now in cultivation. Flowering throughout the season. Height, 1 to $1\frac{1}{2}$ feet. It is rich in albuminoids.

No. 25.—Elymus Virginicus, L. (Lyme Grass, Smooth Rye Grass).

Native, a luxuriant perennial, giving a heavy crop of succulent green fodder during June and July. It must be cut early, or the hay becomes coarse and harsh. Thrives best in rather moist soil. Flowering period, July 10 to 25. Height, 4 feet. Although the analysis was made at what was considered the best stage of growth, our figures do not place this grass very high in nutritive qualities.

No. 26.—Eragrostis Abyssinica, Link. (Teff).

An introduced annual from India and the East, where the seed forms an important article of food. It produces a very heavy crop of feed, of medium quality, which is eaten by cattle, but apparently without much relish. The seed does not ripen until October, and the vitality of Canadian grown seed lessens rapidly year by year. Flowering period, August. Height, 3 feet.

Festuca duriuscula, L. (Hard Fescue).

A hardy fine-leaved grass suitable for rocky pastures.

Nos. 27 & 28.—Festuca elatior, L. (Tall Fescue).—Nos. 29 & 30. —Festuca pratensis, L. (Meadow Fescue).

Introduced from Europe; perennials and among the best adapted to cultivation in Canada. Both of these grasses are perfectly hardy, and produce heavy hay crops of good quality. They also provide excellent pasture in early spring and late autumn. The Meadow Fescue is now considered merely a variety of the Tall Fescue. It is of a more slender habit and does not yield quite so heavily, but the hay is finer. These nutritive and productive grasses should always be included in permanent pasture mixtures. Flowering period, June 20 to 30. Height, 2½ to 4 feet. In *Festuca pratensis* we find an exception to the fact that the percentage of albuminoids decreases between the periods of "just speared" and "seed formed." Our analyses show no deterioration in nutritive qualities during that time.

Festuca ovina, L. (Sheep's Fescue).

A small but valuable grass for upland or rocky pastures.

No. 31.—Hierochloa borealis, R. & G. (Holy Grass, Indian Hay).

Fig. 5.—Holy grass.

Native, perennial. One of the earliest grasses, flowering by the middle of May. It is very sweet-scented, and when cut or fed off, keeps continually producing young leaves. A small quantity in hay imparts a very sweet odour to the other grasses. When once established, however, it is very persistent, and in Manitoba is rapidly becoming a noxious weed most difficult to eradicate. It cannot therefore in any case be recommended for cultivation there and should be introduced everywhere with caution. Our analyses prove it to be a very rich grass. Horses and cattle eat it readily.

This is the grass of which the leaves are used by the Indian women to weave the scented "Indian Hay" baskets and mats. The name Holy-Grass is derived from an ancient European custom of strewing it about churches on festival days. It is dedicated to the Virgin Mary on account of its sweetness.

No. 32.—Holcus lanatus, L. (Velvet Grass.)

Introduced, perennial. A fine growing grass covered with soft whitish hairs. Although the chemical analysis shows that it has considerable nutritive value, its cultivation cannot be recommended, as it is too tender for the Canadian winter, and cattle do not eat it readily.

Nos. 33 & 34.—Kœleria cristata, Pers. (Western June Grass).

Native, perennial. A poor bunch grass of the western plains, not touched by cattle when anything else is obtainable. Flowering period, June 20 to 30. Height, 2 feet. From its composition, however, as depicted in the subjoined table, it does not appear to be wanting in nutritive qualities.

Lolium Italicum, Braun (Italian Rye-grass).

A succulent annual grass suitable only for mixtures intended for one year's crop.

No. 35.—Lolium perenne, L. (Perennial Rye-grass).

Introduced. This standard European grass is not sufficiently hardy to stand the climate in most parts of Ontario and Quebec, and cannot be advantageously introduced into pasture mixtures which are required to last for more than one year. Where the climate will permit of its being cultivated, it is a valuable and nutritious grass. In this latter respect our present analysis places it below the average.

Fig. 6.—Wild Timothy.

No. 36.—Mühlenbergia glomerata, Trin. (Wild Timothy.)—Fig. 6.

Native, perennial. This grass resembles Timothy somewhat in the general appearance of the head, but not in other respects. It has a much branched erect stem, is a heavy cropper, and produces nice, fine hay, highly relished by cattle and horses. One of its special characters is its late flowering. It is very hardy and will grow almost anywhere, although thriving best on low land. Flowering period, August 6 to 20. Height, 3 feet.

No. 37.—MÜHLENBERGIA MEXICANA, Trin. (Satin Grass).

Native, perennial. Like the above, but producing finer hay. Its leafy stems branch at every joint, and it seems to have all the characters of a good hay grass. In good land, it is a heavy cropper, producing from $2\frac{1}{2}$ to 3 tons per acre of hay of high quality. Flowering period, August 6 to 20. Height, 3 feet.

MÜHLENBERGIA SYLVATICA, T. & G. (Bearded Satin Grass).

This grass resembles *M. Mexicana* closely, but has longer stems and produces a heavier crop of hay. The flower panicle is looser and bears slender bristly awns. It has succeeded well in low rich land.

No. 38.—PANICUM CILIARE.

Annual. Seed received from India. A grass closely resembling Crab grass, *Panicum sanguinale*, L. Not worthy of cultivation in this country where we can grow many heavier and better grasses.

No. 39.—PANICUM CRUS-GALLI, L. (Barn-yard Grass).

Native, annual. A tall, coarse grass producing a great quantity of succulent feed, which is highly relished by stock. It grows in low land and around dwellings throughout the country. Flowering period, August. Height, 3 feet. In the early stages of growth it is excellent and nutritious feed; but as it reaches maturity, in common with most grasses, deteriorates rapidly, indeed somewhat more rapidly than any other.

No. 40.—PANICUM VIRGATUM, L. (Switch Grass).

Native, perennial. A late coarse grass, producing heavily and suitable for low land. It must be cut young, as the stems become very hard later in the season. Flowering period, August 5 to 20. Height, 3 to 5 feet. The present analysis does not place it among the most nutritious of those examined.

Nos. 41 & 42.—PHALARIS ARUNDINACEA, L. (Reed Canary Grass.)

Native, perennial. This is the wild form of the well known Ribbon grass of gardens. A luxuriant low land grass, which gives a heavy crop of green leafy stems, over 3 feet high by the 1st of June. If

cut at that time, a second cutting may be made by the 1st of August. This grass grows wild in all parts of Canada in swamps and wet places. The seed, which resembles Canary seed, is not very freely produced, but in suitable soil the plants increase rapidly from their roots; however, it is not a difficult species to eradicate, like some other grasses with this habit. The harsh and fibrous character of the mature grass precludes its recommendation save for soiling when cut early and for use in swampy pastures.

Nos. 43 & 44.—Phleum pratense, L. (Timothy).

Introduced, perennial. No grass is better known or more highly prized by Canadian farmers. On the whole, it is perhaps the most profitable hay grass which can be grown. Though somewhat coarse and hard, especially if allowed to stand too long, yet if cut at the proper time, it makes excellent hay, greedily eaten by horses and cattle. The great advantages of Timothy are, its growth is vigorous, the hay is heavy, it is easily cured and can be handled and pressed without waste and it is of recognized value, owing to which it meets with a ready sale. The seed is freely produced, easily saved, cleaned and handled. Moreover, it is always obtainable in the market when required. Timothy, however, has some defects which must not be overlooked: when cut too early, the bulbs at the bases of the stems are injured, so that only a weakly growth is produced afterwards. These bulbs also make it particularly susceptible to injury by mice and insects. It is unsuitable for pastures, as horses, sheep and pigs crop it too close, when it is apt to be winter-killed. There is practically no aftermath. All of these points go to show that Timothy is not a perfect grass, and it would be well for farmers throughout the country to supplement their pastures and meadows with other varieties which up to the present have been much neglected, and deemed unworthy of notice as producers of "wild hay."

The analyses here given, showing the composition of the plant taken while spearing and after the seed had become mature, afford an excellent illustration of the depreciation in nutritive value which takes place in the latter stages of the plant's life, and point unmistakeably to a grave error when Timothy is allowed to ripen its seed before mowing. The large decrease in the most valuable of all the constituents, viz., the albuminoids, is accompanied by an increased percentage of fibre, which by this time has become very hard and indigestible.

Nos. 45 & 46.—Poa compressa, L. (Canada Blue Grass, Wire Grass).—Fig. 7.


Fig. 7.—Canada Blue grass.

Native, perennial. A rather small species, somewhat resembling June grass, but easily distinguished by its numerous flat stems. This is a very hardy grass, which withstands the effects of drought and will thrive in almost any soil. Thus it is particularly well suited for rocky pastures. It flowers about the 1st of July, but the stems remain green for a long time, and it makes fair hay even when the seeds are ripe. The hay although short is very heavy and rich. When fed green to cattle, they appear to prefer it to all other grasses. The analyses show it to be low in water and consequently rich in dry matter—which constitutes the real cattle food. It compares most favourably with the best in the amount of albuminoids. The statement made, when speaking of Timothy, concerning the loss of albuminoids and the increase of fibre as the plant matures, receives another illustration in the analyses of this grass.

Poa nemoralis, L. (Wood Meadow Grass).

A small rich European grass, closely resembling our native *Poa serotina*.

No. 47.—Poa Nevadensis, Vasey (Nevada Bunch Grass).

Native, perennial. A small species of bunch grass, which on the western plains helps to make up the supply of rich pasturage found there. From its small size, this grass is scarcely worthy of cultivation, even in the west. Flowering period, June 15 to 30. Height, 1 foot. As regards nutritive qualities, our analyses prove its dry matter to be rich in flesh-forming constituents.

Nos. 48 & 49.—Poa pratensis, L. (June Grass, Kentucky Blue Grass) —Fig. 8.

Fig. 8.—June grass.

Native, perennial. This grass is as a rule not so highly valued by farmers as it deserves. This is perhaps due to the fact that its chief value is in its leaves, which although freely produced from early in the spring till late in the autumn are not always recognized as belonging to the weak flowering stems which appear in June. There are also various forms, some of which are much better agriculturally than others. We have under cultivation at the Experimental Farm eight of these forms which are very distinct. On the whole, however, we consider June grass as undoubtedly the most valuable pasture grass in the country. All stock relish it. If kept fed off, it produces more continuously than any other grass.

The percentage of albuminoids in the young grass is above the average, making it a rich and nutritious fodder. The analyses bear out and confirm the good opinion expressed of this grass as an excellent one for all pasture mixtures.

No. 50.—Poa pratensis, "White form."

Native, perennial. Grown from seed collected in the North-west Territories. This is a very early handsome form with wide pale leaves and conspicuously glaucous panicles, which become very much contracted. It is almost a bunch grass producing very few and short runners. It is not unlike some forms of *Poa cæsia*. Flowering period, June 1 to 15. Height, 2 to 2½ feet; leaves, 1 foot

long. It is proved by analysis to be a rich grass. It is high in dry matter and albuminoids and low in fibre. Taken at the same stage of growth, it will be seen to be very similar in composition to *Poa pratensis.*

Nos. 51 & 52.—Poa serotina, Ehrh. (Fowl Meadow Grass).

Native, perennial. A fine soft grass producing an abundance of slender stems which remain green a long time after the seed is ripe. This excellent grass has been sparingly cultivated for 150 years. It grows well in low grounds, and gives almost as heavy an aftermath at the end of August as the first crop which is ready for cutting in the beginning of July. The hay is soft, possesses high nutritive qualities and is well liked by stock. Flowering period, July 1 to 10. Height, 18 inches to 2 feet.

No. 53.—Setaria glauca, Beauv. (Yellow Fox-tail).

Annual, originally introduced, but now a common weed all through North America. Of no agricultural value, although occasionally found growing luxuriantly in stubble and waste places. Flowering period, August. Height, 1 to 2 feet. It cannot be considered a rich grass, though when young it possesses nutritive qualities of value.

No. 54.—Setaria Italica, Kunth. (Hungarian Millet, Bengal Grass).

Introduced, annual. A valuable grass for a catch crop, owing to its rapidity of growth and the late date at which it may be sown. It succeeds well on dry light land and produces a heavy crop of hay, which must be cut early. Height, 2 to 2½ feet. It is not among the best grasses, rapidly deteriorating as it matures so as to be practically worthless when ripe, save for the seeds. The young crop, however, furnishes a wholesome and valuable fodder.

No. 55.—Sporobolus heterolepis, Gray (Fetid Drop-seed Grass).

A native perennial grass of the plains, producing many long fine leaves. This grass will grow in almost pure sand or in stiff clay. When in flower, it emits a strong peculiar unpleasant odour which may be detected for a long distance from the plants. Animals eat the leaves readily, but they reject the flowering stems. Flowering period, July 15 to 25. Height, 2 feet. The high percentage of dry matter and its fair composition give it a place among the grasses of good quality.

General Conclusions from the Analytical Data.

Period at which to cut for hay.

A study of the table will show that the following general changes take place in the composition of grasses as they approach maturity: The water, ash, albuminoids and fat decrease, while the fibre, and usually the nitrogen-free extract, increases. In the case of the three first named constituents, there are but very few exceptions to this rule. The drying out of the grasses as they mature is universal, and for this reason the very young grass shoots are more succulent and palatable than the leaves and stems of the older plant, though not containing, weight for weight, as much dry matter.

It has already been mentioned that the composition of a grass is not constant under all circumstances, but is much affected by environment; the percentages of ash and of albuminoids depend largely on the richness of the soil, and as they vary, so must the other constituents vary. But there are exceedingly few instances in which the percentages of ash and albuminoids in the dry matter do not gradually decrease as the plant grows older. It is during the early stages of the plant's life that it more particularly takes its mineral constituents and nitrogen from the soil. As the grass increases in size and is about to form its seed, the ash and the nitrogen, representing the albuminoids, being now taken up by the roots in lessening quantities, are distributed throughout a greater bulk of the plant, and thus their percentage in the dry matter is reduced. The decrease in amount of ash is not important from a feeding standpoint, but the diminution of the albuminoids presents an important problem when considering the best time at which to cut for hay.

The "ether extract" or "crude fat" also decreases, but since it possesses but a small percentage of true fat or oil, this cannot be looked upon as a serious deterioration.

The fibre of the dry matter not only increases in amount, but also in indigestibility, as the plant matures, becoming hard and woody. This is almost invariably the case.

From these conclusions, drawn from a careful consideration of the chemical data, it may be inferred that a loss of much valuable and digestible food material occurs when a grass is allowed to mature before it is cut for hay. The weight of scientific evidence is all in favour of cutting at, or shortly after the flowering period,

though the exact stage at which it would be most economical to cut any particular grass has as yet not been ascertained with accuracy. Regarding this question, Dr. Clifford Richardson, of Washington, who has made a study of the composition of American grasses, says : "Although largely a matter of opinion, it would seem from the foregoing (chemical) results that the time of bloom or very little later is the fittest for cutting grasses to be cured as hay. The amount of water has diminished relatively, and there is a proportionately larger amount of nutriment in the material cut, and the weight of the latter will be at its highest point economically considered. Later on, the amount of fibre becomes too prominent, the stalks grow hard, arid, indigestible, and the albuminoids decrease, while the dry seeds are readily detached from their glumes and lost with their store of nitrogen."*

Much of the nutriment, and more particularly of the albuminoids, passes from the stem and leaves to be stored up in the seed as the plant matures; the stems and foliage are thus more or less impoverished of their most valuable constituent, and as already pointed out, their fibre is rapidly increasing both in amount and indigestibility. In harvesting a grass with ripened seed, much loss of the latter must ensue. Added to this, there is the fact that many ripe seeds, enclosed in their hard integuments, pass through the animal undigested. It is, therefore, obvious on all counts that the advice given above should be followed out.

II.—GRASSES FROM MANITOBA AND THE NORTH-WEST TERRITORIES.

Samples of some of the more commonly occurring prairie grasses were gathered by the Superintendents of the Experimental Farms at Brandon and Indian Head, in the condition of hay. The analyses, therefore, represent their composition as cropped by stock in the natural, dry state. This, of necessity, implies that they were not procured in the condition at which experiment has proved grasses are the most nutritious; most of them were fully ripe and some had shed their seed. They, therefore, must not be compared strictly with those grasses already commented upon, which were grown under good cultivation and cut, for the most part, at the right period of growth. Considering the great deterioration that takes place as grass ripens, and the result of our present analyses, we may

*Vasey, G. The Agricultural Grasses of the United States, Washington, 1889, p. 138.

safely infer that many of the native grasses of the prairies are of a highly nutritious order, possessing valuable feeding qualities and further, that the conditions of climate, and especially the absence of late rains, tend to the preservation of the valuable pasture constituents in the naturally cured grasses.

Under cultivation and if cut earlier, many of these grasses would undoubtedly show a great improvement in composition. The rich, fertile character of most of the soil in Manitoba and the North-west Territories and the heavy yields of native prairie grasses are facts widely known. In addition, we have the strong probability, proved in the case of wheat, a member of the grass family, that the short season is conducive to an early and large development of the albuminoids. The indications, therefore, are that with due care and in a favourable season, pasture and meadow grasses may be grown equal, if not superior, to those of any part of Canada.

The usual amount of water in old country hay is stated at 14 per cent; in these North-west hays it was invariably in the neighbourhood of 8 per cent, and therefore their composition was calculated upon that basis. From our data it may fairly be inferred that the naturally cured grasses of the prairie do not contain more than this amount. They consequently are rich in dry matter and thus afford to grazing cattle a correspondingly greater amount of real cattle food (though not quite so rich in the flesh forming albuminoids) than an equal weight of hay produced in a moister climate.

Many of the grasses whose composition is here tabulated have already been commented upon. The character and agricultural value of the remainder will now be given.

No. 62.—Agrostis scabra, Willd. (Tickle Grass).

A common native species with hair-like root leaves and very large loosely flowered panicles. Of no agricultural value. Height, 1 foot. In composition it is very similar to *A. vulgaris*, already treated of (No. 7).

Nos. 65 and 66.—Andropogon provincialis, Lam. (Turkey-foot).

Native, perennial. A strong growing grass, found in dry soil. Where it occurs, it is highly valued both for hay and pasture, but we do not know of its having been cultivated. The stems are leafy and when young eaten with avidity by stock. They become

hard and woody after flowering. Flowering period, August. Height, 3 to 4 feet. This sample was evidently taken too late to give a correct idea of its composition at the stage when it is relished by stock. (Identical with *A. furcatus*, Michx).

Nos. 67 and 68.—Andropogon scoparius, Mx. (Indian Grass).

Native, perennial. More slender than the last and very much of the same nature agriculturally. Height, 2½ feet. Our analyses show it is inferior to the preceding, though this may be partially due to its age when taken.

No. 69.—Ammophila longifolia, Vasey (Woolly Reed Bent Grass).

Native, perennial. A tall reed-like grass. Abundant throughout the prairie region on sandy ridges, with hard stems and long slender leaves. Flowering period, August. Height, 4 to 5 feet. We have not yet had an opportunity of determining the agricultural value of this grass.

No. 70 & 71.—Beckmannia erucæformis, Host., var. uniflorus, Scrib. (Slough Grass).

Native, perennial. A tall coarse grass of the west, making remarkably soft hay. It grows naturally in wet sloughs or low ground. In many parts of Manitoba and the North-west Territories, it is abundant and forms valuable fodder much relished by cattle. Flowering period, June 15 to 30. Height, 2 to 3 feet. These samples undoubtedly represent the plant in two stages of growth. It will be noticed that No. 71 is much more valuable than No. 70, containing twice the amount of albuminoids and being consequently more nutritious.

No. 73.—Bromus Kalmii, Gray (Kalm's Brome Grass).

Native, perennial. A small hairy species, found in dry rocky woods. Flowers in June. Height, 18 inches to 2½ feet. Of no agricultural value.

No. 78.—Elymus Americanus, V. & S.

Native, perennial. A slender grass somewhat resembling *Elymus Canadensis*, but finer and less robust. Flowering period, July 20 to August 1. Height, 2½ to 3½ feet. We are not in possession of

sufficient data to enable us to pronounce definitely as to the agricultural value of this variety.

Nos. 79 & 80.—ELYMUS CANADENSIS, L. (Canadian Lyme Grass).

Native, perennial. A coarse grass found on river banks and among the bushes in low ground. From our experience at Ottawa, it is apparently not very suitable for cultivation in open fields. Flowering period, July 20 to August 1. Height, 4 to 6 feet. It requires to be cut early to make good hay. In composition it compares most favourably with other wild grasses from the North-west and from this aspect must be considered as possessing considerable value.

No. 81.—GLYCERIA AQUATICA, Sm. (Reed Meadow Grass).

Native, perennial. A tall soft, succulent grass, with a large panicle and broad leaves, found growing in wet soil and swampy meadows. This grass produces a large quantity of coarse hay and is eaten readily by cattle when cut green. It is one of the few good grasses which will grow actually in water. Flowering period, July. Height, 4 feet. The analysis shows it to be possessed of high nutritive qualities.

Nos. 88, 89, 90.—SPARTINA CYNOSUROIDES, Willd. (Fresh-water Cord Grass).

Native, perennial. A tall slender grass found on banks of streams and in marshes. In the Maritime Provinces it is very much cut for hay and is highly esteemed under the name of "Broad-leaf." It is claimed to have high feeding value by some, but others state that it is very poor feed, and has little worth beyond the bulk that it gives to a hay crop, and the artificial value due to its having a good name. Flowering period, August. Height, 5 to 6 feet. Sample No. 90 was obtained from the Maritime Provinces. It is considerably below the average in albuminoids and possesses a high percentage of fibre. Samples 88 and 89 from the North-west appear somewhat better.

No. 92.—SPOROBOLUS CUSPIDATUS, Scrib.

Native, perennial. A small, hair-like species, of no bulk nor agricultural value. In composition it is seen to rank as a fair grass as regards albuminoids, though too high in fibre to be placed with the better varieties here mentioned.

TABLES OF ANALYSES OF GRASSES.

I.—ANALYSES of Grasses grown at the Central Experimental Farm, Ottawa.

II.—ANALYSES of Grasses from Manitoba and the North-west Territories.

I.—ANALYSES of Grasses grown at

No.	Name.	Stage of growth.
1	Agropyrum caninum, Bearded Wheat grass.	Just before spearing
2	" "	In flower
3	" glaucum, Colorado Blue-stem	Not speared, leaves only
4	" "	In flower
5	" repens, Quack	"
6	" tenerum, Western Rye grass	Seeds fully formed
7	Agrostis vulgaris, Red top	In flower
8	" dispar	"
9	Alopecurus pratensis, Meadow Fox-tail	"
10	Bouteloua oligostachya, Grama grass	"
11	Bromus ciliatus, Fringed Brome grass	"
12	" inermis, Awnless Brome grass	Speared; anthers not extruded
13	" "	Seed fully formed
14	" Pumpellianus, Western Brome grass	Speared; flowers not expanded
15	" "	Seed fully formed
16	" segetum	In flower
17	Buchloë dactyloides, Buffalo grass	"
18	Ceratochloa australis, Southern Brome grass	"
19	Cinna pendula, Drooping Reed grass	"
20	Deschampsia cæspitosa, Tufted Hair grass.	Seed just formed
21	" cæspitosa, var. Bottnica, Rocky Mountain Hair grass	In flower
22	Deyeuxia Canadensis, Canadian Blue-joint.	Seed ripe
23	" neglecta, Neglected Blue-joint	Seed just formed
24	Eleusine Indica, Crow-foot grass	Seed formed
25	Elymus Virginicus, Lyme grass	In flower
26	Eragrostis Abyssinica, Teff	Seed formed
27	Festuca elatior, Tall Fescue	Speared; flowers not expanded
28	" "	In flower
29	" pratensis, Meadow Fescue	Just speared
30	" "	Seed formed
31	Hierochloä borealis, Holy grass	Seed half ripe
32	Holcus lanatus, Velvet grass	Just past flowering
33	Kœleria cristata, Western June grass	Spikes in sheath
34	" "	Seeds fully formed
35	Lolium perenne, Perennial Rye grass	In flower
36	Mühlenbergia glomerata, Wild Timothy	"
37	" Mexicana, Satin grass	Seed formed
38	Panicum ciliare	"
39	" Crus-galli, Barn-yard grass	In flower
40	" virgatum, Switch grass	"
41	Phalaris arundinacea, Reed Canary grass	Leafy stem; not in flower
42	" "	
43	Phleum pratense, Timothy	Just speared
44	" "	Seed formed
45	Poa compressa, Wire grass	Just past flowering
46	" "	Seed formed

the Central Experimental Farm, Ottawa.

In Fresh or Green Material.						Calculated to Water-free Substance.				
Water.	Ash.	Protein (Albuminoids).	Fibre.	Nitrogen-free extract (Carbohydrates).	Ether extract (Fat).	Ash.	Protein (Albuminoids).	Fibre.	Nitrogen-free extract (Carbohydrates).	Ether extract (Fat).
72·33	2·11	6·82	5·96	11·41	1·37	7·64	24·68	22·00	47·40	4·94
66·14	1·64	2·98	14·33	14·40	·51	4·86	8·81	42·34	42·48	1·51
75·76	1·64	4·44	5·97	11·09	1·10	6·76	18·31	24·62	45·73	4·58
63·21	1·75	4·48	12·87	16·44	1·25	4·75	12·19	34·99	44·67	3·40
72·88	2·02	4·54	8·15	11·57	·84	7·45	16·75	30·03	42·66	3·11
62·51	2·14	5·27	14·74	14·97	·37	5·71	14·06	39·35	39·90	·98
61·62	2·29	3·09	13·95	17·95	1·10	5·99	8·06	36·36	46·71	2·88
60·39	2·37	3·44	12·50	20·64	·66	5·99	8·69	31·54	52·11	1·67
81·53	1·66	2·25	6·21	7·82	·53	9·04	12·18	33·67	42·24	2·87
63·02	3·12	4·99	11·18	17·23	·42	8·45	13·50	30·24	46·65	1·16
57·68	1·66	3·94	14·06	21·85	·81	3·93	9·31	33·23	51·62	1·91
81·78	1·73	3·21	6·14	5·50	1·64	9·03	17·62	33·72	35·42	4·21
65·07	1·32	4·14	11·73	16·90	·84	3·78	11·88	33·90	48·03	2·41
77·32	1·81	3·61	7·46	13·94	·87	8·00	15·93	32·71	39·51	3·85
62·33	1·61	4·35	10·93	19·81	·97	4·28	11·58	29·05	52·51	2·58
78·17	1·89	4·18	6·69	8·62	·45	8·69	19·18	26·12	43·95	2·06
59·86	2·73	4·81	11·62	20·57	·41	6·81	12·00	28·97	51·37	·85
80·33	1·64	3·24	6·36	8·01	·42	8·30	16·50	33·37	39·66	2·17
68·00	2·98	6·75	7·86	13·60	·81	9·32	21·12	24·58	42·43	2·55
57·13	2·15	3·53	15·41	21·23	·55	5·03	8·25	35·98	49·44	1·30
68·03	1·66	4·49	10·04	15·22	·56	5·19	14·06	31·35	47·65	1·75
56.69	2·02	4·57	16·06	19·28	1·38	4·68	10·56	36·09	45·49	3·18
67·64	2·29	5·76	9·93	13·34	1·04	7·07	17·81	30·71	41·18	3·23
76 46	2·32	3·53	6·61	10·75	·33	9·88	15·00	28·12	45·59	1·41
68·38	1·26	2·62	11·34	16·01	·39	4·04	8·29	39·04	47·38	1·25
67·73	2·20	4·33	10·16	14·99	·59	6·83	13·43	31·48	46·44	1·82
76·63	1·61	3·84	6·98	10·12	·82	6·90	16·43	29·86	43·31	3·50
74·38	1·72	2·93	9·88	10·55	·54	6·73	11·44	38·61	41·08	2·14
78·01	1·50	3·63	6·37	9·67	·82	6·84	16·50	28·97	43·94	3·75
70·31	2·45	4·91	7·96	13·97	·40	8·28	16·56	26·27	47·55	1·34
75·32	1·64	4·93	6·14	10·68	1·29	6·63	20·00	43·25	24·88	5·24
73·31	2·24	4·11	6·88	12·91	·55	8·40	15·43	25·79	48·30	2·08
71·65	1·95	6·73	6·78	11·08	1·81	6·86	23·75	23·93	39 08	6·38
57·88	2·60	5·31	16·77	16·69	·75	6·18	12·62	39·85	39·56	1·79
79·40	1·59	2·12	6·22	10·17	·50	7·72	10·50	30·83	48·44	2·51
62·72	2·86	5·40	11·19	17·37	·46	7·67	14·50	30·03	46·56	1·24
49·78	2·39	4·64	14·92	27·59	·68	4·77	9·25	29·72	54·91	1·35
78·08	1·64	2·61	5·22	11·95	·50	7·50	11·94	23·83	54·45	2·28
85·30	1·64	2·02	4·48	6·25	·31	11·16	13·75	31·09	41·87	2·13
68·03	1·50	2·14	11·08	16·54	·71	4·72	6·69	34·68	51·69	2·22
67·55	2·22	5·39	7·35	16·62	·87	6·84	16·62	22·67	51·19	2·68
80·16	1·31	3·00	5·69	9·40	·44	6·61	15·12	28·62	47·43	2·22
79·07	1·71	3·51	5·84	9·03	·84	8·18	16·79	28·43	42·58	4·02
65·18	1·34	2·86	10·63	19·47	·52	3·84	8·22	30·54	55·90	1·50
62·15	2·24	3·83	9·67	21·47	·64	5·93	10·13	26·09	56·16	1·69
57·50	2·35	3·50	12·42	23·27	·96	5·53	8·24	29·24	54·72	2·27

I.—Analyses of Grasses grown at the Central

No.	Name.	Stage of growth.
47	Poa Nevadensis, Nevada Bunch grass...	Just speared....................
48	" pratensis, June grass	Flowers formed, but anthers not extruded ....
49	" "	Seed formed.......... ....
50	" " "white form"........	Flowers formed, but anthers not extruded ....
51	" serotina, Fowl Meadow grass	Just speared....................
52	" "	In flower and seed...... ....
53	Setaria glauca, Yellow Fox-tail............	" " ....
54	" Italica, Hungarian Millet..........	In flower....... ....
55	Sporobolus heterolepis, Fetid Drop-seed grass..........	Seed formed....................

Experimental Farm, Ottawa—*Concluded.*

In Fresh or Green Material.						Calculated to Water-free. Substance.				
Water.	Ash.	Protein (Albuminoids).	Fibre.	Nitrogen-free extract (Carbohydrates).	Ether extract (Fat).	Ash.	Protein (Albuminoids).	Fibre.	Nitrogen-free extract (Carbohydrates).	Ether extract (Fat).
72·55	1·43	5·26	8·92	10·70	1·14	5·22	19·18	32·15	39·29	4·16
69·55	1·99	5·70	8·89	12·40	1·47	6·53	18·75	29·19	40·71	4·82
66·43	1·66	3·31	11·10	16·48	1·02	4·94	9·87	32·07	50·06	3·06
65·91	1·64	5·73	7·90	17·46	1·36	4·80	16·81	23·16	51·23	4·00
72·83	2·03	4·12	7·19	12·73	1·10	7·49	15·18	26·50	46·77	4·06
67·57	2·18	3·93	11·83	13·54	·95	6·74	12·12	36·48	41·73	2·93
75·09	2·04	2·00	7·15	13·25	·47	8·21	8·06	28·73	53·09	1·90
68·06	1·91	2·91	9·40	17·24	·48	6·00	9·13	29·44	53·93	1·51
55·45	2·10	4·79	12·61	24·59	·46	4·73	10·75	28·32	55·17	1·03

II.—ANALYSES of Grasses from Manitoba

No.	Name.	HAY Water.	Ash.
56	*Agropyrum caninum, Bearded Wheat grass......	8·00	5·50
57	† " "	8·00	5·92
58	* " glaucum, Colorado Blue-stem........	8·00	7·97
59	† " "	8·00	10·26
60	* " tenerum, Western Rye grass.........	8·00	5·32
61	† " "	8·00	7·23
62	*Agrostis scabra, Tickle grass.................	8·00	7·84
63	* " vulgaris, Red Top	8·00	8·28
64	*Deschampsia cæspitosa, Tufted Hair grass........	8·00	5·80
65	†Andropogon provincialis, Turkey-foot......	8·00	7·92
66	* " "	8·00	5·08
67	* " scoparius, Indian grass...........	8·00	4·86
68	† " "	8·00	8·09
69	†Ammophila longifolia, Woolly Reed Bent grass...	8·00	4·94
70	*Beckmannia erucæformis, Slough grass...........	8·00	7·58
71	† " "	8·00	10·30
72	†Bromus ciliatus, Fringed Brome grass...........	8·00	7·08
73	* " Kalmii, Kalm's Brome grass...............	8·00	4·53
74	* " Pumpellianus, Western Brome grass	8·00	4·68
75	†Deyeuxia Canadensis, Canadian Blue-joint........	8·00	10·11
76	* " neglecta, Neglected Blue-joint..........	8·00	6·67
77	† " "	8·00	9·59
78	†Elymus Americanus............................	8·00	6·44
79	* " Canadensis, Canadian Lyme grass........	8·00	7·77
80	* " "	8·00	9·04
81	†Glyceria aquatica, Reed Meadow grass.........	8·00	10·12
82	†Mühlenbergia glomerata Wild Timothy.........	8·00	6·05
83	† " Mexicana, Satin grass.............	8·00	8·36
84	†Phalaris arundinacea, Reed Canary grass.......	8·00	8·92
85	*Poa serotina, Fowl Meadow grass................	8·00	8·17
86	† "	8·00	10·19
87	† "	8·00	5·69
88	*Spartina cynosuroides, Fresh-water Cord grass...	8·00	4·61
89	† " "	8·00	5·98
90	‡ " " "Broad-leaf".............	8·31	4·53
91	†Sporobolus heterolepis, Fetid Drop-seed grass....	8·00	4·94
92	* " cuspidatus...........................	8·00	5·36

*Collected at Indian Head, N.W.T.
† " Brandon, Man.
‡ " Sackville, N.B.

and the North-west Territories.

OF GRASSES.				CALCULATED TO WATER-FREE SUBSTANCE.				
Protein (Albuminoids).	Fibre.	Nitrogen-free extract (Carbohydrates)	Ether extract (Fat).	Ash.	Protein (Albuminoids).	Fibre.	Nitrogen-free extract (Carbohydrates).	Ether extract (Fat).
5·65	38·52	41·03	1·29	5·98	6·15	41·87	44·60	1·40
5·53	41·92	36·60	2·03	6·44	6·01	45·56	39·78	2·21
6 86	43·89	31·48	1·80	8·66	7·46	47·70	34·22	1·96
12·59	36·37	29·05	3·73	11·15	13·68	39·53	31·58	4·06
5·13	35·34	44·44	1·77	5·79	5·58	38·41	48·30	1·92
6·41	37·35	39·26	1·75	7·85	6·97	40·60	42·68	1·90
8·28	33·18	41·28	1·42	8·52	9·00	36·07	44·87	1·54
8·10	38·46	34·75	2·41	9·00	8·81	41·80	37·77	2·62
4·22	38·56	42·28	1·14	6·30	4·59	41·91	45·96	1·24
5·59	36·57	39·05	2·87	8·61	6·08	39·75	42·44	3·12
6·01	43·80	35·82	1·29	5·52	6·53	47·61	38·94	1·40
4·43	36·65	44·85	1·21	5·29	4·80	39·84	48·75	1·32
4·08	41·78	36·22	1·83	8·80	4·43	45·42	39·36	1·99
6·73	35·44	41·98	2·91	5·37	7·32	38·52	45·63	3·16
8·00	42·29	31·01	3·12	8·24	8·69	45·97	33·71	3·39
15·76	26·31	35·31	4·32	11·20	17·13	28·60	38·38	4·69
9·03	27·27	45·74	2·88	7·70	9·82	29·64	49·71	3·13
5·52	35·15	45·17	1·63	4·93	6·00	38·21	49·10	1·76
4·29	38·48	42·54	2·01	5·09	4·66	41·83	46·23	2·19
8·51	39·69	30·80	2·89	10·99	9·25	43·14	33·48	3·14
5·04	37·69	40·93	1·67	7·25	5·47	40·97	44·49	1·82
6·82	35·05	36·27	4·27	10·43	7·40	38·10	39·43	4·64
7·18	26·90	49·41	2·07	7·00	7·80	29·24	53·71	2·25
11·87	33·56	36·73	2·07	8·45	12·90	36·48	39·92	2·25
13·17	32·13	35·18	2·48	9·83	14·32	34·92	38·24	2·69
11·87	34·55	34·43	1·03	11·00	12·90	37·56	37·42	1·12
8·28	37·05	37·51	3·11	6·58	9·00	40·27	40·77	3·38
4·89	43·17	33·56	2·02	9·09	5·32	46·92	36·47	2·20
12·26	23·07	43 33	4·42	9·69	13·33	25·08	47·09	4·81
4·89	35·38	41·95	1·61	8·88	5·31	38·46	45·60	1·75
7·66	40·20	32·62	1·33	11·08	8·32	43·70	35·45	1·45
6·22	32·95	44·44	2·70	6·19	6·75	35·81	48·31	2·94
5·52	38·66	42·36	·85	5·01	6·00	42·02	46·05	·92
5·11	38·46	41·09	1·36	6·50	5·55	41·81	44·66	1·48
3·66	33·69	47·92	1·89	4·94	3·99	36·47	52·54	2·06
6·74	35·44	41·98	2·90	5·37	7·32	38·52	45·63	3·16
8·13	46·23	30·93	1·35	5·83	8·83	50·25	33·62	1·47

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DEPARTMENT OF AGRICULTURE.

CENTRAL EXPERIMENTAL FARM.

OTTAWA, CANADA.

BULLETIN No. 20.

TUBERCULOSIS.

FEBRUARY, 1894.

PUBLISHED BY DIRECTION OF THE HON. A. R. ANGERS, MINISTER OF AGRICULTURE.

To the Honourable

The Minister of Agriculture.

Sir,—I have the honour to submit for your approval the 20th bulletin of the Experimental Farm series in which is treated the subject of Tuberculosis, a disease which has spread and is spreading among cattle to a considerable extent in almost every part of the world where these animals are kept. The history of the occurrence of this disease at the Central Experimental Farm, the investigations which have been made regarding it and the measures taken for eradicating it are fully given. The reliability of tuberculin as a ready method of diagnosing this disease has been further confirmed, and it is believed that by the general use of this fluid the means is at hand for the detection of all cases of the disease, and if detection be followed by prompt isolation, disinfection, and disposal of affected animals there would assuredly result after a time a greater immunity from this dangerous malady. The possibility of this disease being communicated from animals to the human family adds very much to the importance of the subject from a sanitary standpoint.

This bulletin is offered as the result of the joint labours of the Director and the Agriculturist with the hope that the facts presented may be found useful to the public, and especially to the farmers and stockmen of this country.

I have the honour to be

Your obedient servant,

WM. SAUNDERS,

Director Dominion Experimental Farms.

Ottawa, 8th Feb., 1894.

TUBERCULOSIS.

BY

WM. SAUNDERS, *Director*,

AND

JAS. W. ROBERTSON, *Agriculturist*.

The term tuberculosis is applied to a disease commonly known in the human family as consumption. It is one of the most terribly destructive and fatal of all the diseases to which humanity is subject ; one seventh of the entire death rate of the world is said to be due to it. It is also the most widely distributed and destructive disease found among cattle ; but is much more common in some countries than in others. It occurs in cattle wherever they are kept in domestication, but seems to be most prevalent where consumption is most common in the human family. It is a disease entirely distinct from pleuro-pneumonia. Tuberculosis is also prevalent among swine, but it is rare in the sheep, goat, dog and horse, although all these animals are more or less subject to it. Fowls also are sometimes attacked by it, and occasionally the poultry yard is decimated by its ravages.

Tuberculosis is the most common disease among wild animals in captivity, and sometimes under such circumstances affects captives, representing species which are not known to suffer from this disease in their native haunts, a result no doubt partly due to confinement, and the lack of outdoor exercise and pure air so important to the preservation of the health of animals.

It has long been known that tubercle contained a virus or poison which if injected into the tissues of animals was capable of producing tuberculosis, but the exact nature of this material was unknown until 1882, when Professor Koch of Germany announced

his discovery of the germ of tuberculosis, a bacillus known as *bacillus tuberculosis*, which is now admitted by all scientific investigators to be the sole cause of this disease. This germ is a vegetable parasitic micro-organism which, under a high magnifying power, appears as a fine rod, often slightly bent or curved, about one-tenth as broad as long, and measuring about one seven-thousandth of an inch in length When this bacillus finds lodgment in an animal under favourable conditions it multiplies with great rapidity. Within this minute organism small oval spores are formed which are fast liberated and develop into mature forms like the parent. As a result of the multiplication of these bacilli in any of the internal organs small nodular bodies are formed called tubercles. These in their early stages are about the size of a millet seed, but soon increase in number and size, and uniting form larger diseased masses. As these grow older a process of suppuration takes place, the tubercle becomes yellow, gradually softens and forms a cheesy mass. This mass of cheese-like consistence may soften still more and become of the consistency of cream, or from the deposition of lime salts in it, the mass may become quite hard. When present in any quantity in the interior of such organs as the lung or liver, tubercle is most frequently soft, or fluid, forming what is known as a tubercular abscess, but where the disease affects the surface of an organ, or attacks a membrane the growth is usually harder and nodular.

Those tubercles or portions of tubercle near the surface of a diseased area contain the largest number of active bacilli and these are thus in a favourable position to invade the surrounding healthy tissue, or to be carried by the circulation to other parts of the body and begin there the formation of further tuberculous masses.

Modes of Attack.

The bacillus of tuberculosis may enter the body and bring on this disease of the animal by being taken with the air into the lungs, by being swallowed with food and thus introduced into the digestive system, or in rare cases by the accidental application of disease germs to cuts, wounds or other excoriated surfaces.

Since the disease is found in a very large proportion of cases—probably three-fourths or more—in the lungs it is evident that the usual way in which tuberculosis is contracted is by inhaling the

germs with the air. That the disease may be produced by swallowing the germs of tubercle appears to have been demonstrated by experiments conducted with various animals such as calves, pigs, rodents, fowls, &c., which have been fed with portions of tubercle and tubercular secretions, with the effect of producing this malady. There are also some cases on record in the human family, particularly among infants where the contraction of the disease seems to have been directly connected with the use of milk from diseased cows in which these bacilli are known to occur. The danger to an infant in using such material is much greater than it would be to an adult, for the reason that the tissues of young children are much less resistent, and milk constitutes their chief food.

Development and Spread of the Disease.

When the germs are introduced into the system, and become established there, the disease may become general, or may only develop locally by attacking a single organ. Sometimes when introduced into the blood the bacilli multiply very rapidly, and become distributed over the whole body producing what is called general or acute tuberculosis, and occasionally known in human beings as rapid or "galloping" consumption. Such attacks usually terminate fatally in a very short time. In other cases the disease affects for a considerable period only those parts of the tissues adjacent to the starting point, and in such instances the progress of the disease is slow and the symptoms often obscure.

In cattle the lungs, the glands in the thorax, the pleura and the serous membrane which covers the walls of the thorax and abdomen, are the parts most usually affected by this disease. The liver also in many cases becomes seriously involved, and sometimes the udder of cows, the bowels, brain and other parts of the body. The glands in the chest located behind the lungs are very commonly diseased and often much enlarged, and in post mortem examination will frequently be found filled with solidified tubercle. If the udder is affected the disease usually manifests itself there by small yellow tuberculous spots discernible on the cut surface. The bacilli are seldom found in the muscular tissue or flesh of animals, still the chance of their being present there or in the blood, is a risk too great to allow of the flesh or milk of an animal known to be tuberculous to be used as food unless it has been

heated for some time above the point known to destroy the life of these disease germs which is considerably under the boiling point of water, or about 160°F.

The tubercle bacillus is contained in very large numbers in the matter expectorated by individuals suffering from this disease, also by cows who are said to discharge this material through the nasal organs, and these bacilli remain actively virulent for a very long time. Experiments have been tried by drying such expectorated matter for many months, and also by alternately wetting and drying the material ; the bacilli have also been exposed for a considerable time to cold, as low as 18 degrees of frost, and to temperatures as high as 108°F. without affecting their vitality. When animals have been inoculated with material so treated, the bacilli have shown unimpaired vigour, and have rapidly brought about diseased conditions. It is evident then that such discharges when allowed to dry on a handkerchief or on the floor of a sick room, or in the stalls or sheds of animals suffering from the disease, become a source of danger to all about them, both men and animals. When rooms or buildings, where such material has been deposited and dried, are swept these microscopic bacilli will often rise with the dust and may thus be taken with the air into the lungs.

These germs may be cultivated outside of the animal body by transferring them to the serum of blood, or some other suitable culture medium contained in a small glass tube plugged with cotton. If this tube is kept at the temperature of the body the serum gradually becomes covered with a number of whitish stripes and points which represent millions of these bacilli. Animals inoculated with material from a culture thus prepared soon develop tuberculosis.

No reliable remedy has yet been discovered for this disease, and the only way known of freeing a herd of cattle from it is by the prompt destruction of all affected animals. From the absence of outward symptoms the detection of tuberculosis in its early stages by the ordinary methods of examination is very difficult, and in many cases practically impossible, and by the time the disease has progressed far enough to be readily detected there is danger that the affected animal has already conveyed it to others. This is often the case with the local and slowly developing form of the disease,

even when it occurs in the lung, and frequently an animal may be so affected when to all appearance it is in excellent health and condition. When, however, the disease is general, or when it has so far advanced as to involve a considerable portion of the lungs, symptoms of emaciation occur, there is a gradual wasting away with more or less cough attended with some difficulty of breathing, and where animals are so affected the disease soon proves fatal. A cow attacked by tuberculosis may die in a few weeks, or may live for many months, and sometimes for several years, depending upon the organs involved and the rapidity with which the disease progresses. The percentage of milking animals affected is usually greatest in the neighbourhood of cities where they are housed for the greater part of the year, and is much less in those herds fed for the greater part of the time in the open air. Hence the importance of sanitary measures such as proper ventilation, pure water supply, adequate disinfection of stalls where tuberculous animals have been kept, and prompt isolation of all suspected cases. All conditions which tend to lower the vitality and impair the vigour of the system are predisposing causes of this disease both in human beings and in cattle. Among these are deficient nourishment, ill ventilated and over crowded apartments and exhaustive secretions. There is little doubt that the reason why milch cows are more subject to the disease than steers arises from the fact that the secretion of milk is more or less exhausting to the system of the animal.

The diagnosis of this disease by ordinary means being in many cases almost impossible a more trustworthy method has been sought and found. In 1890 Professor Koch who discovered the bacillus, the true cause of the disease, published a paper detailing some experiments he had made with a fluid—the composition of which was a secret—on guinea pigs, and on people suffering from tuberculosis which led to the hope that this might prove a remedy for the disease. The fluid became known as Koch's lymph or tuberculin. After extensive trial as a remedy for consumption physicians have failed to realize the results hoped for and its use for that purpose has been almost discontinued. Recent experience has, however, shown the usefulness of this fluid as an indicator of this disease in cattle, and a large demand has arisen for it for that purpose.

Preparation of Tuberculin.

Tuberculin is prepared by first making an artificial culture of the disease germ known as the bacillus of tuberculosis and allowing it to stand until the material has become highly charged with the bacilli. A proportion of glycerine is added with a little carbolic acid. It is then filtered through porous porcelain to separate the germs and the filtered fluid raised to a temperature high enough to destroy any remaining germs which may be in the fluid. 70 degrees Centigrade equal to 158° of Fahrenheit is about the temperature used for this purpose. An exposure of ten minutes to such heat is said to destroy all traces of vitality in these germs. The sterilized fluid is next evaporated at a low temperature in a vacuum until it is sufficiently concentrated when it is put up in small bottles each containing five cubic centimeters equal to about 80 minims. When finished this fluid may be said to be a glycerine extract containing the products formed during the life of the bacilli. The preparation of tuberculin requires much skill and care, and hence it is expensive. The small bottles referred to cost at wholesale in Germany, in lots of ten, about $5.25 per bottle, while they are usually sold in New York at about $10 each.

How to use the Lymph.

To prepare this fluid for use it is diluted with nine times its volume of a one per cent solution of carbolic acid in pure water. When a small quantity of this diluted tuberculin is injected under the skin of a tuberculous animal the temperature of the body rises considerably, while in animals free from this disease no such effect is produced. The rise in temperature does not take place immediately, but occurs at different periods from 3 to 20 hours after the injection has been made. The reaction occurs in the larger proportion of cases in from 9 to 16 hours. The duration of the high temperature also varies. Neither the length of time after injection before the reaction takes place nor the length of the high temperature period, affords any positive evidence of the extent or virulence of the disease. The special value of the tuberculin lies in the fact that the increase of temperature takes place even in very early stages of the disease, and that it is equally effective no matter where the disease is located. In the tests conducted at the Central Experimental Farm the quantity of the diluted tuberculin used for each animal has varied from 40 to 80 minims (equal to $2\frac{1}{2}$ to 5

c.c.) according to size and apparent strength. On this basis the material for each injection would cost from 27 to 54 cents. The injection is made under the skin usually just behind the shoulder blade with a hypodermic syringe, and care must be taken to disinfect the syringe before using it. For this purpose we have used a four per cent solution of creolin in water, in which the syringe should be immersed for some time before using. Where several animals are to be treated in succession the needle of the syringe should be disinfected after each time of using by dipping it in this fluid. The hair and skin where the injection is to be made should also be disinfected by wetting it with the same fluid shortly before the injection is made. The normal temperature of each animal is taken several times as shown in the tables in this bulletin by inserting a clinical thermometer into the anus and leaving it there for about three minutes.

Experience at the Central Experimental Farm.

The first case of this disease which occurred at the Central farm was in July, 1891, when a Jersey cow, Orionda's Girl, age 5 years and two months, which had been ailing for some time, sank rapidly, and died 15th July, within six weeks after calving. The post-mortem examination in this instance showed both lungs to be badly diseased with tubercle, the thoracic glands were also much affected and enlarged, forming a tuberculous mass weighing about 2 lbs. Her calf, age 1 month and 11 days, was at once killed. It had been prematurely born, was a weakly creature and, on opening its body, small deposits of tubercle were found on the diaphragm and in the liver.

From this time forward a close watch was kept on the cattle, they were several times examined by veterinary surgeons and any showing symptoms of disease were promptly isolated.

A young Durham bull was the next victim, Duke of Belvoir. He had been in poor health for some months, had been examined and treated by a skilful surgeon without showing any improvement, and on the advice of the doctor was killed on 10th August, 1891, age 2 years 3 months. The left lung was found to be badly diseased, and three of the thoracic glands were filled with a cheese-like tubercular deposit.

On the 21st of September following a Durham cow, Flower of Berkeley, died after a few days' illness, age 5 years. The post mor-

tem in this case showed one lung affected with tuberculosis and several of the internal organs much inflamed. The tubercle in the one lung was not sufficient to account for the death of the animal and the cause of death was believed to be internal inflammation.

On the 29th of the same month a Polled Angus cow, Dolly Varden, age 4 years 3 months, which had shown symptoms of the disease, and had been isolated for some time, was killed on the advice of the veterinary surgeon, and both lungs were found to be badly diseased with tubercle.

At this time there were four other cows, all Durhams, which had been isolated from the rest of the herd as soon as the first symptoms were detected. These animals were placed under the best veterinary treatment without improvement, and on the advice of the surgeon two of them were slaughtered on 28th November, 1891. One of these, Ury, age 3 years 5 months, had both lungs badly diseased ; the other, Guelder Duchess, age 4 years 7 months, was found to be in a similar tuberculous condition. The other two were kept under treatment, and one of them, Maggie Bly, became badly affected early in 1892 with dropsy and her body was much swollen. She was killed 2nd February, 1892, age five years and no post mortem was made. While there was no positive proof of the tuberculosis in this instance, it is probable that the cow was suffering from it as she had symptoms similar to those which other animals, subsequently found to be tuberculous, have shown.

The remaining cow, Cherry Constance, was killed 30th May, age 4½ years, and both lungs were found to be diseased with tubercle. Thus seven cows and one bull were lost between 15th July, 1891, and 30th May, 1892.

Prior to this time the only methods of determining the presence of tuberculosis were by observation of the symptoms, and physical examination (auscultation and percussion) ; and unless the disease was considerably advanced and located in the lungs its detection with any degree of certainty was practically impossible. As all the remaining animals appeared to be healthy and vigorous, it was hoped that this trouble was ended, but during the next few months six other cows began to manifest obscure symptoms which led to the belief that they might be affected with this disease, and they were all accordingly isolated. In this lot there were three grade cows, Ruth, Lily, Anna, one Durham, Miss Elgins,

and one Holstein, Dorinda 3rd. The usefulness of tuberculin as a means of ascertaining the presence of this disease had in the meantime been demonstrated ; and through the kindness of Prof. Ramsay Wright, of Toronto University, a sufficient quantity of the lymph was obtained to test a portion of the herd.

At the outset two of the healthiest looking and most vigorous cows in the barn, a Devon, Ethel, and a grade, Pansy, were chosen to be tested with the suspected animals to serve as a basis for comparison, and the normal temperature of each cow was taken at intervals on three separate days, as shown in the tables, followed by injection of the lymph on the 21st November, at 8 p.m.*

NORMAL TEMPERATURES, NOVEMBER 15TH, 1892.

Name of Animal.	9 A.M.	11 A.M.	2 P.M.	5 P.M.	8 P.M.
Ruth	101	101	101·6	102	100
Lily	100·6	101·6	101	101·4	101·8
Miss Elgins	101·6	101·2	102	101·6	102
Dorinda 3rd	101·6	101·6	102·6	102·6	102·6
Anna	102	101·8	101·8	101	101·8
Pansy	101·6	102·2	102	102	101·6
Ethel	100·8	101·4	102	102	100

NORMAL TEMPERATURES, NOVEMBER 16TH, 1892.

Name of Animal.	5 A.M.	9 A.M.	11 A.M.	2 P.M.	5 P.M.	11 P.M.
Ruth	101·8	101·8	101·4	101·4	101·6	101
Lily	101·4	101·6	101·8	101·8	102·4	101·8
Miss Elgins	102	102	102·2	102·6	102·2	101·6
Dorinda 3rd	101·2	101·4	101·6	102·4	102·6	102·2
Anna	101·4	101·6	102	102·4	101·4	101·2
Pansy	101·6	102·2	101·8	102	102·6	101·8
Ethel	101·4	101·6	101·8	102·2	102·2	101·2

NORMAL TEMPERATURES, NOVEMBER 21ST, 1892.

Name of Animal.	5 A.M.	9 A.M.	11 A.M.	2 P.M.	5 P.M.
Ruth	101	101	100·4	101·2	101·2
Lily	101·2	102	102	101·4	102
Miss Elgins	101·4	101·8	101·8	101·6	102
Dorinda 3rd	101·8	101·2	102·4	102·8	103
Anna	101	101	101·2	101·8	102
Pansy	101·8	101·8	102 4	102	102
Ethel	101·4	102	101	100·8	102·4

* Clinical thermometers are usually graduated to show fifths of a degree, but in th following tables the fractions are all given in tenths.

TEMPERATURE AFTER INJECTION OF TUBERCULIN, 21ST NOVEMBER, 8 P.M.

The quantity of the diluted lymph injected varied with the size and vigour of the animals from 60 to 75 minims.

Name of Animal.	8 P.M.	5 A.M.	7 A.M.	9 A.M.	12.30 P.M.	3 P.M.	6 P.M.	10 P.M.
Ruth......	101	101·4	**102·2**	**105**	**105**	**105·2**	**105·8**	**105·6**
Lily......	101	**102·4**	**103**	**106·4**	**106·2**	**106·4**	**105·8**	**105**
Miss Elgins.	101·8	101·8	**102·6**	**105·4**	**106·6**	**106·2**	**105·4**	**104·8**
Dorinda 3rd.	102·2	101·8	**102·6**	**103·4**	**105·2**	**105·4**	**105**	**104**
Anna......	101·4	101·6	100·8	100·6	101	101	100·8	100
Pansy......	101·2	102	101·6	102	101	102	101·8	**104**
Ethel......	101	101	101·6	**103·8**	**105·8**	**105·6**	**105·4**	**105**

The results of these tests may be thus summarized :

Name of Animal.	Average normal temperature, 16 tests.	Highest temperature after injection.	Rise in temperature above average normal.	Rise in temperature above highest normal.
Ruth.........	101·21	105·8	4·69	3·8
Lily.........	101·5	106·4	4·9	4·4
Miss Elgins...	101·85	106·6	4·75	4
Dorinda 3rd...	102·1	105·4	3·3	2·4
Anna.........	101·59	101·6	·01	— ·8
Pansy.........	101·94	104	2·06	1·4
Ethel.........	101·51	105·8	4·29	3·4

The indications were very decided that two grade cows, Ruth and Lily, the Durham, Miss Elgins, and the Holstein, Dorinda 3rd, all had the disease, and that the other grade cow, Anna, whose highest temperature under the action of the tuberculin was but a fraction above the average normal temperature and eight-tenths of a degree lower than the highest normal was free from disease. It also indicated that the Devon cow Ethel, which had been selected for comparison, as one of the healthiest animals in the herd, also the grade cow Pansy chosen for a similar reason, were both tuberculous. These last named results were such a surprise that after a careful consideration of the whole matter we decided not to destroy the animals at once on the indications the tuberculin had given, but to continue to isolate those which had shown the reaction, watch their progress for a time and test again.

For the next eight months the animals which had shown the reaction with the lymph were kept isolated, and their symptoms

were noted, but at the end of this period there was not very much change. Miss Elgins and Dorinda 3rd seemed to be gradually wasting away, but Ethel was as fat and frisky as ever, and Pansy maintained her condition well, and these were both given further respite. In the meantime an Ayrshire cow, May, and a Jersey cow, Barberry, had both manifested suspicious symptoms and had been removed to hospital quarters. On the 17th of July, 1893, the normal temperatures were again taken with the following results :

NORMAL TEMPERATURES, 17TH JULY, 1893.

Name of Animal.	6 A.M.	9 A.M.	1 P.M.	4 P.M.	7 P.M.	10 P.M.	2 A.M.	5 A.M.	9 A.M.
Ruth.........	101	101	100·8	100·8	100·4	100·6	99·8	100·8	100·8
Lily	103	101	103	101	101	100·6	100	100·6	100·6
Miss Elgins ..	102	103	104	104	105	103·8	103·4	102·6	103·2
Dorinda 3rd..	103	101	101·8	101	100·8	100·6	101·8	102	101
May.........	101·2	102	103	103	101	102·8	102	100·6	102·2
Barberry.....	100·6	100·4	101	101	101	101	101	102·2	100·8

The second injection of the tuberculin was made on the following day, but as Miss Elgins had recently calved and her average normal temperature 103·4, and her highest normal 105·, showed that she was in a highly feverish condition, the test in her case was deferred. It will also be observed that both Lily and May reached the unusually high point of 103· in their normal temperature.

TUBERCULIN INJECTED 10.30 TO 11 A.M., 18TH JULY.

Name of Animal.	No. of minims injected.	1 P. M.	4 P. M.	7 P. M.	10 P. M.	1 A. M.	4 A. M.	7 A. M.	10 A. M.	1 P. M.
Ruth	65	100·6	101·2	102·2	**102.2**	**103·8**	**104·4**	**105·4**	**105**	**106**
Lily....	70	100·8	**103·8**	**105**	**106**	**106**	**105**	**103·6**	101·6	101
Dorinda 3rd	70	101·2	101·2	101·8	102	**104·4**	**104·6**	**103·4**	**103**	102
May.... ..	65	**103·8**	**104·6**	**106·2**	**106·2**	**106·2**	**104·6**	**103·4**	**103**	**104·2**
Barberry ..	60	102	102	**102·8**	**103·8**	**105·8**	**105**	**104 6**	**103·2**	**103**

An analysis of these figures gives the following results :

Name of Animal.	Average normal temperature, 9 tests.	Highest temperature after injection.	Rise in temperature above average normal.	Rise in temperature above highest normal.
Ruth..........	100·67	106	5·33	5
Lily..........	101·2	106	4·8	3
Dorinda 3rd...	101·45	104·6	3·15	1·6
May.........	101·76	106·2	4·24	3·2
Barberry......	101	105·8	4·8	3·6

It will be observed that the reaction in the case of Dorinda 3rd was less on this occasion than when she was first tested. Then the highest temperature was 105·8, and the rise in temperature above the highest normal was 3·2. This we afterwards attributed to the fact that the tuberculin rarely causes so strong a reaction after a second injection even where several months intervene, and when a second injection is made shortly after the first, the reaction is usually very slight or none at all, although the animal may be badly diseased. Hence the results of the first test should be regarded as the most reliable.

On 21st July four animals were killed.

The plan adopted in all cases was to kill first those animals of least value and those in which the evidence of disease was most marked, reserving the more valuable animals until we were satisfied by post mortem examination that the indications given by the tuberculin could be relied on.

Ruth, a Grade Cow, Age about 11 Years.

On post mortem, both lungs were found to have large masses of tubercular matter in their substance, the thoracic glands were also found to be partly filled with solidified tubercle. There were a few grapy masses of tubercle on the interior lining of both the thoracic and abdominal cavities, and a considerable quantity of this diseased material was attached to the womb. The liver and other internal organs appeared to be healthy.

Lily, a Grade Cow, Age 9 Years.

In this instance masses of tubercle of a cheesy consistence were found in portions of both lungs and on parts adjacent. There were also grapy tubercular deposits attached to the windpipe and distributed over a large part of the inner lining of the thorax. Small lumps of similar diseased material were found on the outer surface of the liver, and also over the surface of the mesentery. The liver, apart from the superficial spots referred to, appeared to be in a fairly healthy condition, the udder also was free from disease.

May, an Ayrshire Cow, Age, 9 or 10 Years.

The right lung was much diseased with solidified masses of tubercle extending all through it, the other lung was scarcely affected. The thoracic glands were enlarged and almost filled with tubercle, and the lining of the thoracic cavity was dotted in many places with granular lumps of tubercular deposit. Tubercular matter was also found in spots in the abdominal cavity, and a large mass of tubercle was found attached to the outside of the womb. The liver and udder appeared to be in a healthy condition.

Barberry, a Jersey Cow, Age 6½ Years.

The lungs of this animal were healthy and no tubercle could be detected in them, the inner lining of the cavities of the chest and bowels were also free from disease, and the udder appeared to be healthy. On cutting through the liver it was found to be badly diseased, having large and small cavities filled with granular masses of whitish tubercular matter of varying consistence. In some of the smaller cavities the material was as fluid as pus. The liver was enlarged and adhering to the side, and more than one-half of its entire substance was occupied by these cavities containing diseased matter.

On the 23rd July the Devon cow Ethel and the grade cow Pansy were again tested, and with them six others taken from the herd, all of which were supposed to be healthy. These consisted of one Devon, Fanny B, two Ayrshires, Maggie B and Countess, two Durhams, Fashion and Elmwood Garland, and one grade cow, Blossom. The normal temperatures were taken on the 23rd July and the tuberculin injected on the 25th.

NORMAL TEMPERATURES TAKEN JULY 23RD, 1893.

Name of Animal.	5 p.m.	8 p.m.	2 a.m.	5 a.m.	8 a.m.	11 a.m.
Ethel	101	101·2	100·6	100·6	101	101
Pansy..	101	100·8	100·2	100·8	100·8	100·2
Fanny B.........	100·6	101	100·2	100·4	100·4	100·4
Maggie B...... ..	100·8	100·6	100	100·4	100·8	101
Countess.	100·8	101	100·4	100·4	100·8	100·6
Fashion....	101·4	101	101	101·2	101·2	101
Elmwood Garland	101·8	102	101	101	101·4	101·4
Blossom.	101·2	101	100·8	101·2	101·2	101

TEMPERATURES AFTER INJECTION OF TUBERCULIN,
11 to 11.30 a.m., July 24th.

Name of Animal.	No. of minims injected.	2 p.m.	5 p.m.	8 p.m.	11 p.m.	3 a.m.	5 a.m.	8 a.m.	11 a.m.
Ethel	62	101·2	101·6	**102·6**	**102·4**	**102·8**	102	101·2	101
Pansy..	70	100·4	101·4	101·2	101	101·8	**102·4**	101·2	101·4
Fanny B.	57	100·4	101	101·4	100·8	**102·6**	**103·2**	**102·8**	**104·2**
Maggie B	65	101	101 6	101·2	100·8	100·4	100·4	101	100·6
Countess..........	62	100·6	101·4	101	102	**103·6**	**104**	**103·3**	**103**
Fashion	75	101·6	101·8	**103·6**	**105·6**	**106·2**	**105·2**	**105**	**104·8**
Elmwood Garland	80	101·6	102	**102·2**	**103·3**	**105·8**	**105·4**	**104·4**	**103·6**
Blossom...........	70	101	101	100·6	**102·4**	**104·4**	**104·8**	**104·2**	**105·2**

The analysis of these figures shows the following results :

Name of Animal.	Average normal temperature, 6 tests.	Highest temperature after injection.	Rise in temperature above average normal.	Rise in temperature above highest normal.
Ethel...............	100·9	102·8	1·9	1·6
Fanny B..........	100·5	104·2	3·7	3·2
Maggie B.........	100·6	101·6	1	·6
Countess..........	100·67	104	3·33	3
Fashion.	101·13	106·2	5·17	4·8
Elmwood Garland..	101·43	105·8	4·37	3·8
Pansy	100·63	102·4	1·77	1·4
Blossom	101·07	105·2	4·13	4

The results of this test were very discouraging, all the animals seemed to be diseased excepting one of the Ayrshire cows Maggie

B, her rise in temperature above the highest normal being only six-tenths of a degree she was regarded as free from the disease. Ethel and Pansy were being tested a second time, and on this account a strong reaction was not expected, and as to the condition of the remaining five there could be little doubt.

On the 25th July 8 additional animals which had shown no symptoms of the disease were tested. These consisted of three Canadian cows obtained in the Province of Quebec, Babette, La Basque and Alice, one grade heifer, Annie Rooney, a Jersey cow Clenna Rex, and three Holstein cows, Aaggie Cornelia, Louverse 2nd and Dorinda 2nd. Miss Elgins and Dorinda 3rd were also included for another test.

NORMAL TEMPERATURES TAKEN 25TH JULY, 1893.

Name of Animal.	5 p.m.	8 p.m.	11 p.m.	5 a.m.	8 a.m.
Babette	102·6	102	101·8	101	101·4
La Basque	101·2	101	100·4	100·8	100·8
Alice	101	100.8	100	100	100·2
Annie Rooney	102	102	101·6	101·2	101·2
Clenna Rex	101·8	102	100·2	100·6	100·4
Aaggie Cornelia	102·6	102·4	102·0	101·6	101·4
Louverse 2nd	101·8	101	100·8	101	100·4
Dorinda 2nd	102·2	102	101·8	101·8	101
*Miss Elgins	....	....	....	....	101·6
*Dorinda 3rd	....	....	....	....	100·4

*The normal temperature of these cows having been taken so often before, it was taken only at 8 a.m. on this occasion.

TUBERCULIN INJECTED AT 11 TO 11.30 A.M., 26TH JULY, 1893.

Name of animal.	No. of minims injected.	2 p.m.	5 p.m.	8 p.m.	11 p.m.	3 a.m.	5 a.m.	8 a.m.
Babette	60	101·8	102·2	101·8	101·4	101·4	100·2	101
La Basque	70	100·8	101·4	102	**103·2**	**105·2**	**104·8**	**104·4**
Alice	70	100	100·8	100·8	101·2	101	100·4	100
Annie Rooney	70	101·2	101·8	101·8	101·2	101·2	100·8	101
Clenna Rex	70	101·4	101·2	101·8	101·8	102·2	101·8	101
Aaggie Cornelia	80	101·4	**102·6**	**103**	**105·8**	**105·4**	**105·6**	**104·4**
Louverse 2nd	80	101	101·2	101	101·2	**102·4**	**103·2**	101·8
Dorinda 2nd	80	101·4	**102·2**	**103**	**104·4**	**106**	**105·2**	**103·8**
Miss Elgins	80	102·2	102	**104**	**103**	**102**	**102·4**	**103·4**
Dorinda 3rd	80	101·2	101·2	101·4	101·4	100·4	101·2	100·8

These figures may be thus analysed :

Name of Animal.	Average normal temperature, 5 tests.	Highest temperature after injection.	Rise in temperature above average normal.	Rise in temperature above highest normal.
Babette	101·76	102·2	·44	·4
La Basque	100·84	105·2	4·36	4·
Alice	100·4	101·2	·8	·2
Annie Rooney	101·6	101·8	·2	·2
Clenna Rex	101	102·2	1·2	·2
Aaggie Cornelia	102	105·8	3·8	3·2
Louverse 2nd	101	103·2	2·2	1·4
Dorinda 2nd	101·76	106	4·24	3·8
	One test only.			
Miss Elgins	101·6	104	2·4	2·4
Dorinda 3rd	100·4	101·4	1	1

This analysis indicated one of the three Canadian cows La Basque to be diseased, also the three Holstein cows, although the reaction in the case of Louverse 2nd was not great. Miss Elgins showed a lessened but decided reaction notwithstanding this was the second injection, but Dorinda 3rd, this being the third injection, showed a rise of one degree only.

On the 28th July four of the cows were killed, three of those which had shown the strongest reaction from the tuberculin, Fashion, Elmwood Garland and Blossom, also Miss Elgins.

Fashion, a Durham Cow, Age 8 Years.

Portions of the substance of both lungs were found to be tuberculous, and on cutting open the thoracic glands they were found nearly filled with tubercle. A granular deposit was found on the surface of the thoracic cavity, not very well marked yet distinct. Tubercle was also found in one part of one lobe of the liver. The other internal organs and the udder appeared healthy.

Elmwood Garland, a Durham Cow, Age 8 Years.

In this animal tubercle was found in one lobe of the lungs near the tip. Solidified masses of tubercle were also found in the thoracic glands, and a small mass of the same material was found deposited on the diaphragm. The liver was healthy but the womb was congested, although no tubercle was found about it. One medium sized nail and a piece of fence wire about six inches long

were found in the stomach. This cow was in remarkably good condition and showed the least amount of the disease of any of those yet slaughtered.

BLOSSOM, A GRADE DURHAM COW, AGE 8 YEARS.

No tubercle was found in the lungs of this cow, but one of the thoracic glands was found to be full of tubercular deposit. There were some lumps of tubercle embedded in the substance of the liver and showing on the surface, and a few smaller patches of the same material in spots in the interior of that organ. The udder and womb were healthy.

MISS ELGINS, A DURHAM COW, AGE 9 YEARS.

Tubercular matter was found in masses in different parts of both lungs. The thoracic glands were much enlarged, measuring 6 inches or more in length, and two inches or more in diameter, and were filled with solidified tubercular material. A large cavity was found in the liver filled with creamy white granular tubercle partly fluid, containing a pint or more. Other portions of the liver were much congested and had small patches of tubercle lodged in different parts of the substance.

On the 30th July two of the cows which had been tested on the 24th and 25th were tested again for the purpose of ascertaining the results of a second use of the tuberculin within a week. One of these was Countess an Ayrshire cow which had shown a rise in temperature above the average normal of 3·33 degrees; the other a Canadian cow, La Basque, which had shown a similar rise of 4·36 degrees. The normal temperature which had been recorded five times in connection with the previous test was only taken once on this occasion and that was at 11.30 a.m., immediately before injecting the lymph. At that time the normal temperature of Countess was 100·8, that of La Basque 102·4.

Name of animal.	No. of minims inject'd.	2 P. M.	5 P. M.	9 P. M.	3 A. M.	6 A. M.	8 A. M.	9 A. M.
Countess. . .	68	100·8	101·8	101·8	101·8	101·4	101·2	101
La Basque. .	70	102·4	102·4	102·4	102	102·4	102	102·4

Countess, in the average of these tests, showed only one degree of increase of temperature at the highest point above the normal, and at no time during the test did the temperature of La Basque

rise above the normal point when the test began. Her normal temperature was, however, at that time six-tenths of a degree higher than the average normal in the previous test. This experiment further confirmed the opinion that a second injection of tuberculin made within a few days of the first, has little or no effect.

On the 31st July the normal temperature was taken of the bulls at three different periods and the tuberculin injected the day following. These animals numbered 13 in all and consisted of 1 Durham, 1 Ayrshire, 3 Holsteins, 3 Jerseys, 3 Devons and 2 Canadian bulls, and included all the bulls excepting one old Jersey bull which could not be managed at that time, but was subsequently tested and found free from the disease.

NORMAL TEMPERATURES TAKEN 31ST JULY, 1893.

Name of Animal.	10 A.M.	4 P.M.	5.30 P.M.
Lord Lincoln, Durham, 2 years	102·2	101·2	101·6
MacDuff, Ayrshire, $5\frac{3}{4}$ years	101	100·4	100·6
Netherland Pythias, Holstein, 6 years	100·8	101·4	101·2
Netherland Hero do $1\frac{1}{2}$ do	101·2	101·4	101·2
Netherland Chief do $1\frac{3}{4}$ do	102	102·8	102·6
Barberry Boy, Jersey, 2 years	101	101·6	101·8
Orionda's Prince, Jersey, $2\frac{1}{2}$ years	101·6	101·2	101·6
St. Lambert of Ottawa, Jersey, $2\frac{1}{4}$ years	101·2	101·8	101·6
Hero, Devon, $5\frac{1}{4}$ years	101·4	101·2	101
Earl of Salcomb, Devon, 2 years	100·6	101·6	101·2
Sir Abbott do 2 do	101·2	101·6	101·2
Baptiste, Canadian, $2\frac{1}{4}$ years	101	101·4	101·6
Quintal do $4\frac{1}{2}$ do	100·8	100·8	101

TEMPERATURE AFTER INJECTION OF TUBERCULIN, 1ST AUGUST, 1894.

Name of Animal.	No. of minims injected.	2 P. M.	5 P. M.	8 P. M.	11 P. M.	4 A. M.	8 A. M.
Lord Lincoln	65	101·2	101·4	**102·8**	**103·6**	**104·4**	**103·4**
MacDuff	80	100·8	100·4	101	100·8	100	101
Netherland Pythias	85	100·8	101	101·4	102	102	101·4
Netherland Hero	50	101·2	101·2	101	102	**103·8**	**102·6**
Netherland Chief	45	102·4	102·8	102·6	102·2	101	100·6
Barberry Boy	40	101·6	101·6	102	101	100	100·8
Orionda's Prince	65	101·2	101·4	101·6	101·2	101·4	100·8
St. Lambert of Ottawa	50	101·4	101	101·2	101	101	100·6
Hero	80	101·8	**102·2**	**105·4**	**105**	**103**	**103**
Earl of Salcomb	40	101·4	101·6	101·4	101	99	101
Sir Abbott	40	101·2	101·8	101·6	101·2	99	101·2
Baptiste	45	101	101·2	101	100	100	100·8
Quintal	75	100·6	100 6	100·6	100·6	101	101·8

An analysis of these figures shows the following results :

Name of Animal.	Average normal temperature, 3 tests.	Highest temperature after injection.	Rise in temperature above average normal.	Rise in temperature above highest normal.
Lord Lincoln.... ...	101·67	104·4	2·73	2·2
MacDuff..............	100·67	101	·33	None.
Netherland Pythias....	101·13	102	·87	·6
Netherland Hero......	101·27	103·8	2·53	2·4
Netherland Chief.....	102·47	102·8	·33	None.
Barberry Boy..........	101·47	102	·53	·2
Orionda's Prince	101·47	101·6	·13	None.
St. Lambert of Ottawa..	101·53	101·4	—·13	—·4
Hero..	101·2	105·4	4·2	4
Earl of Salcomb.......	101·13	101·6	·47	None.
Sir Abbott	101·33	101·8	·47	·2
Baptiste	101·33	101·2	—·13	·4
Quintal..............	100·87	101·8	·93	·8

The results of the tests with the bulls were much more encouraging than any of those with the cows, showing a smaller percentage of animals diseased, only 3 out of 13 being affected.

On the 12th August the two last remaining of the full grown animals were tested, one of these was a Jersey bull, Actor of Glen Duart, age 7 years 9 months, and the other a grade cow, Lady. The normal temperature of the Jersey bull had been taken three times with that of the other bulls on 31st July when he showed a uniform temperature of 100·4, but the lymph was not used with him at that time.

TEMPERATURE TAKEN 12TH AUGUST, 1893.

Name of Animal.	Normal temperature.		No. of minims injected.	Temperature after injection of tuberculin.			
	10 a.m.	3 p.m.		6 p.m.	9 p.m.	12 p.m.	5 a.m.
Actor of Glen Duart.....	101·4	100·8	75	100·2	100	100	100
Lady..................	100·8	100·6	60	101	101·6	**104**	**105·4**

If we analyse these results we have the following :

Name of Animal.	Average normal temperature, 2 tests.	Highest temperature after injection.	Rise in temperature above average normal.	Rise in temperature above highest normal.
Actor of Glen Duart...	101·1	100·2	—·9	—1·2
Lady........... ...	100·7	105·4	4·7	4·6

These results showed no reaction in the case of the Jersey bull, but a decided increase of temperature in the grade cow.

Among the cattle at this time there were 9 young calves whose dams had been shown by actual post mortem or by test of the tuberculin to be tuberculous. While to all appearance these calves were healthy it would have been unwise to have raised them for breeding stock, as the progeny of diseased parents if they do not actually inherit the disease inherit a tendency to it. As it was not desirable to feed such animals for beef, it was decided to destroy them after submitting them to the action of the lymph. These consisted of 3 Durham bull calves, Fashion Knight, Ottawa Duke and Lord Elgins, 1 Jersey heifer calf, Lily Belle, 1 Devon bull calf, Red Duke, and 4 grade calves, Joe, Barney, Charlie and Billy. The normal temperature of these was taken twice and the tuberculin was injected at 4 p.m. the same day. Particulars of this test will be found in the following table. A Jersey calf Lily Rex, daughter of Clenna Rex (who after testing was considered free of disease), was also tested at this time. This calf was not killed.

Name of Animal.	Age.	Normal Temperature.		No of minims injected.	Temperature after Injection of Tuberculin at 4 p. m.			
		10 a. m.	3 p. m.		6 p. m.	9 p. m.	12 p. m.	5 a. m.
Fashion Knight . .	7 wks.	102	102	11	102·2	102	102	101·6
Ottawa Duke	6 do	101·8	102	10	102	102·6	102·2	102
Lord Elgins	5 do	102	101·8	10	102·4	102·4	**103·4**	102·4
Lily Belle	9 do	101·8	102·2	10	101·6	102·4	102·4	102·2
Red Duke	11 do	101·8	102	12	102	102	101·8	102·4
Joe	3 do	101·6	101·4	10	101·6	101·4	102	102·4
Barney	5 mos.	102	102·2	22	102·2	101·6	101	101·4
Charlie	4 do	101·8	102	20	101·6	101·4	101	102
Billy	3 do	103·4	102·6	20	102	102	101·6	101·4
Lily Rex	3 do	102·4	102·4	20	102·2	102·4	101·8	101·6

An analysis of these figures gives us the following :

Name of Animal.	Average normal temperature, 2 tests.	Highest temperature after injection.	Rise in temperature above average normal.	Rise in temperature above highest normal.
Fashion Knight ...	102	102·2	·2	·2
Ottawa Duke.. ..	101·9	102·6	·7	·6
Lord Elgins. ...	101·9	103·4	1·5	1·4
Lily Belle.........	102	102·4	·4	·2
Red Duke.........	101·9	102·4	·5	·4
Joe................	101·5	102·4	·9	·8
Barney............	102·1	102·2	·1	None.
Charlie............	101·9	102	·1	do
Billy	103	102	—1	—1·4
Lily Rex..........	102·4	102·4	None.	None.

From this it will be seen that there was practically no reaction excepting in the case of Lord Elgins. In this instance, however, the rise in temperature was not great while in the case of Billy, whose normal temperature was unusually high, the temperature after the injection of the tuberculin fell one degree

A post mortem examination was made in each case excepting Lily Rex, and the organs were examined carefully, but no trace of tubercle was found in any of them.

On the 2nd October a final test of the tuberculin was made on the animals remaining which had shown the reaction in previous trials. The normal temperature of each was taken twice, at 8 and 10 a.m., excepting the bulls which were omitted because it was thought at the time that the tuberculin in stock would not be sufficient to inject the whole number. The lymph was injected at 10:30 to 11 a.m. The results are given in the following table :

TEMPERATURES TAKEN OCTOBER 2ND, 1893.

Name of Animal.	Normal Temperature.		No. of minims injected.	Temperature after Injection of Tuberculin.					
	8 a.m.	10a.m.		1 p.m.	5 p.m.	8 p.m.	11 p.m.	2 a.m.	5 a.m.
Ethel	100·8	101	60	101·4	101·4	101·8	101	101·4	100·6
Fanny B......	100·8	100·4	60	100·6	101·8	**102·4**	**103·4**	**102·6**	101·2
Countess	101	101	60	101·4	**102·2**	**104**	**105·6**	**104·4**	**102·2**
Pansy..	100·6	100	65	100·6	102	102	101	100·8	101·2
La Basque. ..	100·4	100·4	60	101·2	102	**102·6**	**103**	**102·4**	**102·2**
Aaggie Cornelia	100·2	101	70	100·4	102	**102·4**	**105·6**	**104·6**	**104·2**
Louverse 2nd...	101·6	101·2	70	**102·4**	**104·2**	**105·8**	**105·4**	**105**	**103**
Dorinda 2nd....	100·4	101	70	100·8	101·8	**103·4**	**105·2**	**104·8**	**103·4**
Dorinda 3rd....	101	100·6	70	101	101·8	102	102	101·4	101·2
Lord Lincoln...	Not	taken.	65	102	102·2	102	101	100·4	100·6
Netherland Hero	Not	taken.	45	100·6	101·6	102	101	102·4	101·8
Hero...........	Not	taken.	80	**102·4**	**104·6**	**105·2**	**103·4**	101·4	101
Lady......	101	100·2	60	100·4	**102·6**	**104·4**	**104·8**	**103·8**	**103·2**

An analysis of this table shows the following :

Name of Animal.	Average normal temperature, 2 tests.	Highest temperature after injection.	Rise in temperature above average normal.	Rise in temperature above highest normal.
Ethel	100·9	101·8	·9	·8
Fanny B..	100·6	103·4	2·8	2·6
Countess	101	105·6	4·6	4·6
Pansy	100·3	102	1·7	1·4
La Basque	100·4	103	2·6	2·6
Aaggie Cornelia...	100·6	105·6	5·5	4·6
Louverse 2nd......	101·4	105·8	4·4	4·2
Dorinda 2nd.......	100·7	105·2	4·5	4·2
Dorinda 3rd..... .	100·8	102	1·2	1
	aver. normal, July 31.			
Lord Lincoln.....	101·67	102·2	·53	None.
Netherland Hero ..	101·27	102·4	1·13	1
Hero	101·2	105·2	4	3·8
Lady..	100·6	104·8	4·2	3·8

A summary giving the number of times each animal was tested with the tuberculin, the dates of testing and the highest temperature reached during each test is here presented :

Ethel—1st test, 15th November, 1892, highest temperature 105·8 ; 2nd test, 23rd July, 1893, 102·8 ; 3rd test, 3rd October, 1893, 101·8.

Fanny B—1st test, 17th July, 1893, 104·2 ; 2nd test, 3rd October, 1893, 103·4.

Countess—1st test, 17th July, 1893, 104· ; 2nd test, 30th July, 1893, 101·8 ; 3rd test, 3rd October, 1893, 105·6.

Pansy—1st test, 15th November, 1892, 104· ; 2nd test, 23rd July, 1893, 102·4 ; 3rd test, 3rd October, 1893, 102.

La Basque—1st test, 26th July, 1893, 105·2 ; 2nd test, 30th July, 1893, 102·4 ; 3rd test, 3rd October, 1893, 103.

Aaggie Cornelia—1st test, 26th July, 1893, 105·8 ; 2nd test, 3rd October, 1893, 105·6.

Louverse 2nd—1st test, 26th July, 1893, 103·2 ; 2nd test, 3rd October, 1893, 105·8.

Dorinda 2nd—1st test, 26th July, 1893, 106· ; 2nd test, 3rd October, 1893, 105·2.

Dorinda 3rd—1st test, 15th November, 1892, 105·4 ; 2nd test, 17th July, 1893, 104·6 ; 3rd test, 26th July, 1893, 101·4 ; 4th test, 3rd October, 1893, 102.

Lord Lincoln—1st test, 31st July, 1893, 104·4 ; 2nd test, 3rd October, 1893, 102·2.

Netherland Hero—1st test, 31st July, 1893, 103·8 ; 2nd test, 3rd October, 1893, 102·4.

Hero—1st test, 31st July, 1893, 105·4 ; 2nd test, 3rd October, 1893, 105·2.

Lady—1st test, 12th August, 1893, 105·4 ; 2nd test, 3rd October, 1893, 104·8.

An analysis of these details shows that there is a lack of uniformity in the results, but it would appear that in most instances a period of from 2 to 3 months after the first injection gives sufficient time to restore that condition which will admit of a second reaction when the lymph is again injected after that lapse of time.

On the 3rd October these animals were all killed and the following particulars recorded as to the results of the post mortem examinations :

Ethel, a Devon Cow, Age 6 Years.

Her general condition was very good up to the last, she was fat and full in form and very active. The post mortem showed one lung sound, but in the substance of the other there were found

many small patches of tubercle. Two of the thoracic glands were also found partly filled with tubercular deposit. One lobe of the liver was diseased at the tip, and there was a grapy deposit of small tubercles on the membrane lining the thorax.

FANNY B, A DEVON COW, AGE 6 YEARS.

One lung was found to be badly diseased with tubercle, the other appeared to be sound, one of the thoracic glands adjacent to the affected lung was filled with tubercular deposit. The liver and other organs were healthy. This cow was also in good condition, quite fat and would have been regarded by any one examining her as in excellent health.

COUNTESS, AN AYRSHIRE COW, AGE 8 YEARS.

In this instance both lungs were found to be tuberculous throughout, but the disease was not so far advanced as in some of the other animals. The thoracic glands were also found to be affected and contained a considerable quantity of solidified tubercle. The liver and other organs were healthy.

PANSY, A DURHAM GRADE COW, AGE 7 YEARS.

The general condition of this cow indicated excellent health. On post mortem both lungs were found to be quite healthy, but tubercular matter was found in one of the thoracic glands ; the liver and other organs were healthy. The disease in this instance was evidently in its earlier stage.

LA BASQUE, A CANADIAN COW, AGE 5 YEARS.

Tubercular deposit was found in both lungs in this animal, there was also a cavity in the side of the liver full of creamy tubercular matter. The other portions of the liver were sound and healthy.

AAGGIE CORNELIA, A HOLSTEIN COW, AGE 5 YEARS.

The general condition of this animal was good and no one would have suspected from her appearance that she was in any way diseased. One lung was found to be considerably affected towards the tip with nodules of tubercular matter, the other lung appeared to be sound. On opening the thoracic glands they were found to be much diseased with tubercle. The liver was healthy.

Louverse 2nd, a Holstein Cow, Age 5 Years.

This cow also appeared to be in very good health and condition much like Aaggie Cornelia. Both lungs were found to be free from disease, but on opening the thoracic glands three of them were found to contain tubercular matter. The liver and other organs were healthy. In this instance also the disease was in its earlier stage.

Dorinda 2nd, a Holstein Cow, Age 8 Years.

This animal was in fair condition, not specially thrifty, but no thinner than many cows are which are large milkers as she was. On post mortem examination, several bean-like lumps of tubercle were found attached to the windpipe. One lung was also diseased with tubercle, while the other appeared to be sound. A large cavity was found in the liver which when opened discharged a quantity of creamy tubercular matter. The remaining portions of the liver appeared to be sound and healthy.

Dorinda 3rd, a Holstein Cow, Age 7 Years.

This animal was scarcely in fair condition, she was thin and showed some physical signs of disease with an occasional short cough. She had been a long time under suspicion and had been isolated for about a year and a-half and her symptoms watched.

One lung was found to be considerably diseased, especially towards the tip, soft tubercular matter oozing out from many points when the lung was cut open. The diseased lung was also found to be adherent to the side. The other lung was sound. In the upper part of one lobe of the liver a large cavity was found containing a pint or more of creamy tubercular material.

Lord Lincoln, a Durham Bull, Age 2 Years.

This young bull had shown symptoms of some internal trouble for several months previous and his growth had not been as thrifty as it should have been in an animal of his age.

One lung was found to be badly diseased with tubercle, in the other no tubercle could be seen, but it appeared to be somewhat congested. A large sac or cyst was found attached to the upper part of the liver which when cut into discharged about a pint of

creamy tubercular matter. The whole interior of this animal had an unpleasant foetid odour. (As a precautionary measure 4 young Durham calves, of which this young bull was sire, were killed.)

NETHERLAND HERO, A YOUNG HOLSTEIN BULL, AGE 1½ YEARS, FROM DORINDA 3RD.

This young bull was only in medium condition. He did not appear to thrive. His dam was badly diseased, and he was born and fed with her milk after she was suspected of having some internal derangement. When opened this animal had a healthy appearance. No distinct evidence of tubercle could be found in either of the lungs, but on the surface of one lung there were small pimply growths of an unhealthy appearance which did not seem to involve any of the substance of the lung below the skin. The tissues of the lungs, liver and other organs appeared to be quite healthy and no traces of tubercle were found in the thoracic glands, or any other part of the body examined.

As the reaction after injection had in this case been suspicious 103·8 and the physical symptoms favoured the view of his being diseased it was expected he would have been found affected. This was the only instance among all the animals which have been killed where a considerable increase in temperature had occurred after the injection of the tuberculin without the presence of tubercle in the internal organs being demonstrated. It is probable that the unhealthy condition referred to of the surface of one of the lungs was due to incipient tubercle. It is quite possible also that tubercle may have existed in some other part of the body and escaped detection.

HERO, A DURHAM BULL, AGE 4 YEARS.

This bull was in good condition, fat, plump and vigorous, and there were no physical signs of the presence of the disease excepting an occasional slight cough.

On examination both lungs were found to be full of tubercular deposit in a creamy or granular condition, in some parts distributed throughout the tissues with much regularity. A considerable proportion of the upper part of one of the lobes of the liver was occupied by a large mass of tubercle, the other portions of the liver appeared to be healthy. There were also a few small grapy tubercular masses on the membrane lining the thorax.

It was a matter of surprise to find that the disease in an animal to all appearance healthy and in such good condition was so far advanced.

Lady, a Grade Durham Cow, Age 3 Years.

In this animal no tubercle could be found in either of the lungs, but two of the thoracic glands were found to contain tubercular deposit. A mass of tubercle was also found attached to the peritoneum covering the diaphragm in the abdominal cavity.

When this stage in the investigation was reached all the animals which had been kept in the barn during the summer had been tested, and it was supposed that the disease was eradicated. There were, however, 15 young animals, 14 heifers and 1 steer which had been out in pasture since early in the spring which had not been tested. As these had been kept away from the rest of the herd and they all seemed healthy, it was not supposed that the disease would be found in any of them. In the meantime the barns were disinfected by thoroughly spraying all parts of the floor, woodwork, walls and ceiling with a strong solution of bichloride of mercury, and by a renewal of the floor and other portions of the woodwork wherever decay was manifest, and subsequently the whole of the woodwork and walls were either painted or whitewashed. Later in the season the young animals were brought in from pasture, but the testing of them was unavoidably delayed until 9th January, 1894, when the normal temperature was taken of 14 of them twice during the morning of that day and the tuberculin injected at 12 noon. One of the young heifers, Lady Elgins, had recently calved and the test in her case was deferred for a few days. The details of the tests are given in the following table :

TEMPERATURES TAKEN 9TH JANUARY, 1894.

Name of Animal.	Age	Normal Temperat're		No. of minims injected.	Temperature after Injection of Tuberculin at 12 noon.					
		10 A. M.	12 A. M.		3 P. M.	7 P. M.	10 P. M.	1 A. M.	4 A. M.	8 A. M.
	mos									
Florence G. (Ayrshire)	10	102	101·6	35	101·6	101·4	101	101·2	101	101
Polly (Polled Angus)	14	101·8	101·4	45	103	102·8	102·6	102	102	101·4
Violette (Canadian)	27	102	101·4	45	101·4	101·4	101·8	103·2	104·2	104·2
La Rouse (Canadian)	12	101·4	101·4	45	101·4	101·6	101·6	101·6	100	102
Miss Eden (Devon)	28	101·6	101·8	55	102·4	103·4	105·8	107·8	105·4	103·2
Aaggie Cornelia 3rd (Holstein)	21	102	101·6	55	101·8	101·6	103·2	106	105·8	102
Lady Cornelia (Holstein)	11	102	102	45	102·2	102·4	102·2	102	102	102
Belle of Glen Duart (Jersey)	16	101·6	101·8	45	101·8	102·2	105·2	105·4	105·4	104·2
Princess (grade)	40	101·6	101·4	60	101·8	103	105·6	107·4	105·4	104·4
Jolie (grade)	12	101·8	102·2	35	102·4	102·4	101·6	101·2	101	101
Jewel (grade)	18	102	101·6	45	101·4	101·8	101·8	101	101·2	101
Julia (grade)	19	101·8	102	50	102·2	102·4	101·8	102·2	101	101
Topsy (grade)	21	101·4	102	55	102·2	102·4	102·2	101	101·6	101
Finlay (grade steer)	15	101·6	102	45	102·2	102	102·4	101·8	100·4	102

An analysis of the above table shows the following results:

Name of Animal.	Average normal temperature, 2 tests.	Highest temperature after injection.	Rise in temperature above average normal.	Rise in temperature above highest normal.
Florence G.	101·8	101·6	—·2	—·4
Polly	101·6	103	1·4	1·2
Violette	101·7	104·2	2·5	2·2
La Rouse	101·4	102	·6	·6
Miss Eden	101·7	107·8	6·1	6
Aaggie Cornelia 3rd	101·8	106	4·2	4
Lady Cornelia	102	102·4	·4	·4
Belle of Glen Duart	101·7	105·4	3·7	3·6
Princess	101·5	107·4	5·9	5·8
Jolia	102	102·4	·4	·2
Jewel	101·8	101·8	None.	—·2
Julia	101·9	102·4	·5	·4
Topsy	101·7	102·4	·7	·4
Finlay	101·8	102·4	·6	·4

The results of these tests show 5 of the heifers out of 13 affected. As the rise in temperature shown by the Polled Angus heifer Polly of 1·20 degrees above the highest normal took place very shortly after the injection of the lymph and gradually declined to

nearly normal by the time the other animals which showed the reaction had reached their maximum temperature, the slighter reaction in this case has in all probability been due to other causes, and she with the other heifers and the steer may be regarded as free from disease.

Lady Elgins, a Durham heifer belonging to this group, age 3 years, calved on 7th January, and was not tested until 16th January. Her normal temperature at 8 a.m. was 102·4, at 11 a.m., 102·8. After the injection of 55 minims of tuberculin her temperature was recorded as follows: 2 p.m., 103·2; 5 p.m., 103·2; 8 p.m, 102·4; 11 p.m., 103·2; 2 a.m., 102; 5 a.m., 102; 8 a.m., 102·2;—As the increase in temperature in this case had only been four-tenths of a degree above the highest normal, she was regarded as free from disease.

The five condemned heifers were at once isolated, and it is proposed to use them for a time for further experimental work with the tuberculin. It is claimed by some physicians that tuberculin when injected has a curative action on the disease; and in order to gain information on this point, these young heifers (in which it is not probable that the disease is far advanced) will be treated with injections of small quantities of tuberculin at intervals and their condition and symptoms recorded. When a sufficient time has elapsed they can be disposed of and the condition of their internal organs ascertained. It is hoped that some valuable information may be gained from this test.

In reviewing the whole of the foregoing facts it will be seen that from the period of the first use of the tuberculin in November, 1892, up to the present time (leaving the 12 young calves which were killed out of consideration) 54 animals have been tested, 26 have given the reaction indicating the presence of the disease, and the other 28 may be regarded as sound and healthy. The tuberculin has proven throughout a most reliable means of diagnosing the disease.

Branch Experimental Farms.

The only shipment of cattle made from the Central Experimental Farm to the branch Experimental Farm at Nappan, N.S., was on 28th November, 1890, when among others a Durham cow, Countess of Darlington, was selected for this purpose as one of the healthiest animals in the herd. During the summer of 1893, nearly 3 years after being sent, the Superintendent of the Nappan Farm

reported this cow as having been some time ailing, and from the symptoms shown it was believed she was suffering from tuberculosis. Instructions were sent to have this cow killed which was done, and on post mortem examination she was reported to be tuberculous. Two heifers of her progeny were subsequently tested with tuberculin by Mr. Robertson, and they were both found to be healthy. The other animals there have not yet been tested and no further symptoms of this disease have been discovered. The cattle on all the branch Experimental Farms are reported by the Superintendents as healthy. Arrangements are, however, now in progress for the testing of all these animals with tuberculin. Action has necessarily been deferred in this particular until the conclusion of the investigations at the Central Experimental Farm, and the experience which has been gained and is given in this bulletin will, it is believed, supply the information needed for the detection of the presence of this disease in cattle wherever it may occur.

Experience Elsewhere in Canada.

Canadian cattle as a rule are remarkably healthy, especially such herds as are kept the greater part of the time in the open air, a result no doubt due to the invigorating and health-giving character of the Canadian climate. It has, nevertheless, been long known that tuberculosis exists to a certain extent in different parts of Canada among cattle kept the greater part of the year in confinement, or when closely bred. Prior to 1888 the subject was much discussed, and during the session of the House of Commons in that year a sub-committee was appointed for the purpose of considering the question of certain contagious diseases in cattle and their communicability to man and animals with special reference to tuberculosis.

The committee presented a report to the House in April, 1889, in which much useful information is given regarding this disease and the means by which it is spread. After a careful consideration of all the evidence which the committee had obtained from physicians and veterinary surgeons in different parts of the Dominion, the members expressed the opinion that the disease known as tuberculosis then existed among cattle in Canada to a much greater extent than was generally recognized. In this report reference was made to the contagious character of the disease, that

it was always due solely to the presence of the tubercle bacilli, and to the fact of its being communicable from animals to man. The committee also recommended that the milk obtained from all suspected animals should be boiled before using, and that the meat where used should be thoroughly cooked so as to destroy any bacilli which might be present.

The occurrence of this disease at Ottawa is unfortunately not an exceptional case. The recent reports in regard to the presence of tuberculosis in cattle at the Ontario College of Agriculture, at Geulph, have mentioned the killing of 22 animals in the dairy herd, while no reports have come to our notice of the testing of the thoroughbred cattle used in connection with the teaching work of the institution. The use of tuberculin in this case, and also in private herds in the central and eastern provinces has shown that the disease is not confined to any one locality.

Prevalence of Tuberculosis in other Countries.

In many parts of the United States the prevalence of this disease has caused grave apprehension and has resulted in two instances in legislative action with the object of protecting the public from danger and of assisting stockmen to overcome this difficulty. Tuberculosis has long been prevalent in the State of New York, and there the legislature has recently provided for the appointment by the State Board of Health of three veterinary inspectors whose duty it is to go through each county, examine the herds and kill infected cattle. The following is the reported method of procedure: A physical examination is first made ; if the disease is suspected tuberculin is used, and where the characteristic reaction takes place the animals are killed. A post mortem examination is made and a report of the internal condition of the animal sent to the secretary of the Board of Health, and subsequently a partial compensation is given by the State to the owners of the animals which have been destroyed.

In a summary of the results of the working of this law during the past year, published in the Country Gentleman of 18th January, 1894, it is said that during the year "many valuable dairy animals, and in fact entire herds, which have taken many years to bring to their high standard of excellence, have been slaughtered. About 20,000 animals were examined by the three inspectors of

the State Board during 1893 (1st January to 31st December, inclusive), and of this number 686 were found infected and killed." These diseased animals were found in 17 different counties in the State showing that the trouble there is wide spread. In the statements which have appeared no mention is made of the testing of apparently healthy herds with tuberculin.

In Pennsylvania similar action has been found necessary and a bill is said to have passed the Senate of the State, and also the House, without opposition, providing for the inspection and quarantining of all animals suspected, for the killing of such as may be shown to be diseased, also for partial compensation to the owners. In several instances which have been published, private owners of large herds in this State in which tuberculosis has occurred have had their animals tested with tuberculin, and in some cases it has been found necessary to kill a large proportion of the herd.

This disease has also been prevalent for a long time in many of the other States of the Union.

Tuberculosis is very prevalent in Great Britain. In the annual report for 1892 of Dr. G. T. Brown, Director of the Veterinary Department of the Board of Agriculture of Great Britain the results are given of the examination of all the animals which have been slaughtered under the Pleuro-Pneumonia Act. These animals were supposed to be healthy and were killed because they had been exposed to the contagion of that much dreaded disease. In this report it is said that of the cows slaughtered in London 25 per cent were tuberculous, in one herd of 20 cows 14 were found affected, and in several herds the proportion was 30 to 40 per cent. Cows slaughtered in Midlothian were found to be tuberculous in the proportion of 20 per cent, in Yorkshire 22·8 per cent, and in Durham 18·7 per cent.

This report further states that the injection of tuberculin has been successful in detecting the disease in something like 90 per cent of the cases. In about 10 per cent the results were found to be uncertain, a few of the tested animals showed no rise of temperature although post mortem examination showed them to be affected with the disease, a few others in which the rise of temperature was marked appeared to be free from tubercle.

The disease also exists in Denmark to a very considerable extent. Tests have been carried on there under Government supervision for more than two years past with the most convincing results. It is said that the proportion of cases in which tuberculin has failed to detect the presence of the disease is not more than 2 per cent. So great is the confidence in which this means of diagnosing the disease is held there, that an appropriation was made by the Danish Government in April, 1893, of 50,000 crowns, equal to about $13,000, to defray the expenses connected with a thorough system of tuberculin tests throughout the kingdom. It is hoped that, by the carrying out of extensive investigations, by an almost universal test of tuberculin, and providing for the necessary disinfection and separation of diseased animals from the healthy ones it will be possible to fight tuberculosis successfully.

In Denmark those animals which show the reaction are isolated and fattened for the butcher. The meat after being inspected must, when offered for sale, be branded with a special stamp which indicates to the public that the animal has suffered from tubercle, and the public are cautioned that such meat must be well cooked, when it is said it may be used without danger.

Dr. B. Bang, who is the chief of the Veterinary Department of the Royal Agricultural College of Denmark, has taken a very active part in investigating this disease. In 1892 he published the results of tests with tuberculin in some of the larger herds of milking cattle in Denmark, in which he found the disease quite prevalent. In one case he reports 80 per cent of the milch cows affected.

In the 24th Bulletin of the Royal Agricultural College of Denmark Dr. Bang refers to some experiments made in Germany by Dr. Kopp, in which 1,058 animals were tested with tuberculin and 738 showed the reaction. Of the total number 243 were heifers, and of these 49·9 per cent showed the reaction, 757 were milch cows, of which 78·9 showed the reaction, and 58 were bulls and steers, of which 69 per cent showed the reaction. Twenty of those animals in which the tuberculin showed a marked rise in temperature were killed and tubercle found in each case, six also which did not show the reaction were killed and they were found to be quite free from tubercle.

Dr. Rockel of Germany reports in the publication of the Imperial Health Office of Berlin, vol. 7, the results of the examination of

cattle killed in slaughter houses in the German Empire during the years 1888-89. Of these the total number found to be tuberculous was 26,352. These are classified according to age as follows :

6 weeks and under	102
6 weeks to one year	79
1 year to 3 years	2,539
3 years to 6 years	8,819
Over 6 years	11,275
No age given	3,538
*Total	26,352

The disease also exists in Russia where Dr. Gutmann of the Veterinary Institute of Dorpat has found the tuberculin a very satisfactory agent for determining the presence of tuberculosis. This disease also occurs to a considerable extent in France, Switzerland, Austria, and other European countries. Indeed it is doubtful if any country where cattle are kept to any extent is entirely free from it.

In view of the prevalence of this disease, and the possibility of its being communicated from animals to man, there is no doubt that its prevention and control are among the most important sanitary questions before the public at the present time, and are deserving of the most careful attention and earnest effort.

* We desire to acknowledge our obligations to Mr. J. J. Mackenzie, B.A., Bacteriologist to the Board of Health for the Province of Ontario, for kindly supplying these details regarding the work in Germany, and also for some other facts mentioned in this bulletin.